Aug 1981

eti

ELECTRONICS TODAY INTERNATIONAL

NZ $2.35 $1.75*

Guide to DATA'81 Computer Show

SIMPLE SOUND EFFECTS PROJECTS

ELECTRONIC STETHOSCOPE

BATTERY CHARGER

REVIEW:
Nakamichi 480Z Cassette Deck with Dolby C

Remote Control Techniques.

WIN
'SUPER INVASION' Games Program for your ZX 80 Computer

The guarantee on our tape is useless.

Because you'll probably never have to use it.

If, however, anything ever goes wrong with any Maxell cassette you buy, through normal use, we'll replace it. Free.

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eti ELECTRONICS TODAY INTERNATIONAL

THE AMATEUR RADIO FRATERNITY is losing good talent to 'other interests' because those who have pursued the hobby, within the bounds of their licences and the regulations, to the fullest extent of their ability and interests reach a watershed where licence and regulation limitations restrict further endeavour. Maybe that's a natural progression, but I've seen many a frustrated talent reach this stage and turn in some other direction through frustration at the limitations. I am talking about those whose interest is primarily technical in nature, not certificate hunters, DXers and the like. Where do these amateurs go when they reach this watershed? Skiing, computing, building model railways, politics ...

I'm not denigrating the undoubted attractions offered in the personal challenges of other pursuits; my argument is that the watershed I speak of need not exist. I think it is high time that another class or level of amateur licence was seriously considered. Apart from broadening the scope and challenge of the hobby, such a licence could be issued to particular amateurs as perhaps a concrete *recognition* of technical achievement.

I can anticipate arguments against my proposal on the grounds that it sets up an elite — which it does, but that's what the amateur licence does anyway. Elite, as defined by the dictionary, means 'the best of' and there are plenty of examples within amateur radio where an elite is identified in particular areas — the DXCC listings for one. Whilst there is recognition for expertise and effort in almost every other sphere of pursuit within the hobby, there's nothing offering for the technically inclined in this country. The 'full' licence is it. And it's predicated on demonstrating a limited mechanical expertise in a mode of transmission — morse code. But this is not the place to argue the pros and cons of code examinations.

I would like to conduct a debate on the subject of a 'higher' class or level of amateur licence — should we have one, or shouldn't we? If so, what should be the 'entrance qualifications', what privileges should be offered? — and so on. No holds barred on this one, we'll publish all reasonable letters on the subject, from anyone — amateur or not. Over to you!

Roger Harrison
Editor

QUICK INDEX

advertisers

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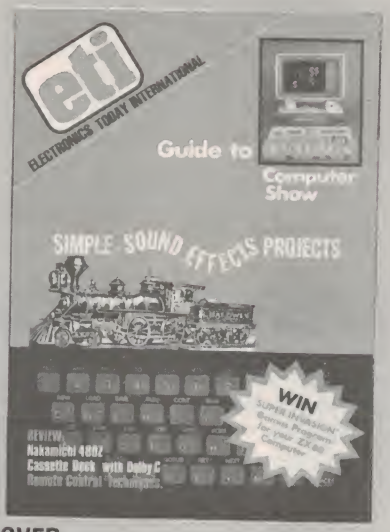


COVER

The nostalgic sounds of the old-time steam train, complete with whistle, can be reproduced with one of our feature projects this month. Australia's biggest annual computer show will no doubt interest many readers and a guide is included inside, too.

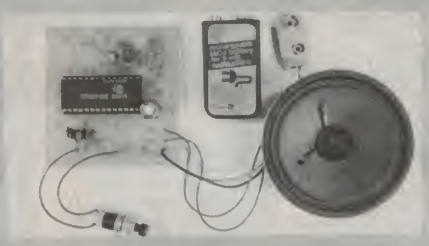
*Recommended retail price only.

features

news

computing

projects



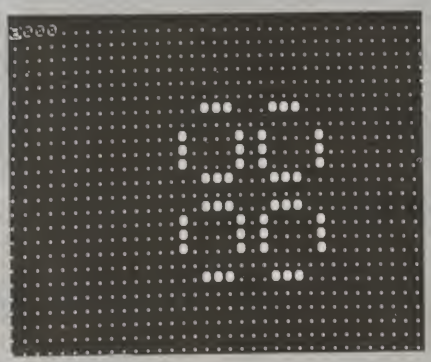
sight & sound

general

next month

THE FUTURE NOW
Electronic gadgetry barely dreamed of a few short years ago is now mass marketed by an industry that turns over more than the gross national product of the USA. Dennis Lingane brings us a report from the world's largest annual electronics show — the Chicago Consumer Electronics Show. A glimpse of the future that's here and now!

LIFE on a 6800
The program of LIFE is a set of rules to define the growth or death of a moss-like form. This article details an interesting variant, specifically for 6800 owners (SWTPC machines, etc).



AUDIO-TECHNICA ATH-8 HEADPHONES
What with all the trumpeting about loudspeakers recently, one would have thought headphones were a dying breed. Not so! This recently released model from Audio Technica is a top-line, top price set of 'phones that Louis Challis considers "... offer a standard of fidelity, total frequency response and other acoustical attributes for which many audiophiles have long aspired but could not otherwise afford."

SERIES 5000 PREAMP Pt. 2
Description and construction of the low-level input stages of the preamp introduced in the July issue.

MORE SOUND EFFECTS
Two more sound effects units to complete the ETI-607 series commenced in this issue. Next month we have a Phasor & Explosion and a Gunshot for you to build.

ALPHASORT PROGRAM
Sorting information alphabetically is one of the most common requirements of file handling and data sorting. You can arrange your printout with this program and never lose track of that special lady's phone number again!

Although these articles are in an advanced state of preparation, circumstances may affect the final content. However, we will make every attempt to include all features mentioned here.

HEY KIWIS! MISSED YOUR DICK SMITH CATALOGUE LAST MONTH!

60 PAGES PACKED WITH ELECTRONIC GOODIES DIRECT IMPORT PRICES

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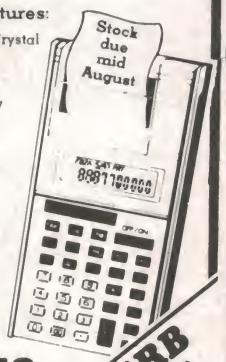
A PRINTER CALCULATOR THAT FITS IN YOUR HAND!

Check these features:

- 10 digit Liquid Crystal Display
- Tab key (floating decimal point)
- Print/no print key
- Percentage key
- Square Root key
- Clear entry key
- Rounding off key



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$NZ 89.50

P&P $4.00

SUPERB VALUE

DIGITAL ELECTRONIC CAR CLOCK

Ideal for your boat, car, or plane. All controls are counted on the front face for time setting, alarm and lock. Quartz controlled for accuracy and comes complete with power leads and brackets for underdash mounting

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3.5 DIGIT LCD DIGITAL MULTIMETER

ONLY

$NZ 95

Cat. Q-1450 P&P $4.00

This 20 range digital multimeter has highly legible LCD for low power consumption. It offers exceptional performance, is easy to use and has overload protection.

NEW LOWER PRICE!

ON THE BRILLIANT SYSTEM 80

- 16K memory
- S-100 expandable
- Compatible with almost all Level II Programs
- Works with any standard TV Set.
- Built-in cassette deck with level control plus provision for another (external) cassette

WAS $1185!

NOW ONLY

Cat. X-4005 P&P $5.50

$NZ 1050

HANDY METER

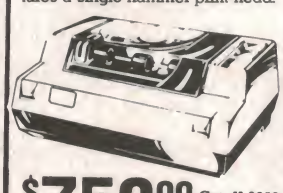
- Diode protected movement
- 20,000 ohms per volt
- 34 ranges

$NZ 35.00 Cat. Q-1024 P&P $3.00

Comes complete with batteries, test leads and instructions

INCREDIBLE VALUE PRINTER

Imagine: a tractor-feed impact type dot-matrix printer for less than most thermal printers! Uses ordinary fan-fold paper and features a single hammer print-head.



$NZ 750.00 Cat. X-3252 P&P $5.50

DICK SMITH FUNWAY

Vol. 1

Shows a fun way into electronics for the raw beginner with 20 exciting kits to build. $NZ 5.95

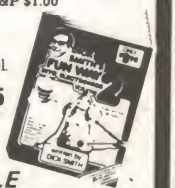
Cat. B-2600 P&P $1.00

Vol. 2

For those at a higher level. Shows how to solder, use a multimeter etc. $NZ 7.95

Cat. B-2605 P&P $1.00

KITS ALSO AVAILABLE



TURN YOUR OLD TV INTO A CRO

This remarkable kit turns any surplus B&W (or color) TV into a 30kHz audio oscilloscope. It is ideal for Hi-Fi and audio display applications

only $NZ 37.95

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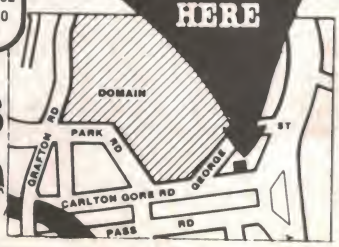
High accuracy QUARTZ STOPWATCH

$NZ 49.50 Cat. Y-1041 P&P $4.00

Ideal for any application, specially suited for the sportsman. Use it as a clock or stopwatch!

WE ARE HERE



DICK SMITH Electronics

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MAIL ORDER CENTRE: Address as above.
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Call into our store and collect your copy of our 1st Edition catalogue!

Facts from Fluke on low-cost digital multimeters.

The 8020A Analyst.

Model 8020A: The Analyst

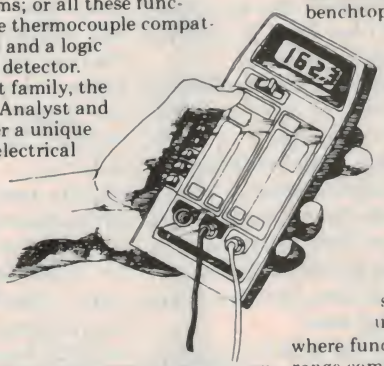
- Seven functions
  dc voltage
  ac voltage
  dc current
  ac current
  resistance
  diode test
  conductance (1/R)
- 3½ digit resolution
- 0.1% basic dc accuracy
- LCD display
- Overload protection
- Safety designed test leads

People who know electronic test and measurement equipment throughout the world recognize Fluke as a leader in the design and manufacture of precision instrumentation – products that speak for themselves in accuracy, reliability and engineering excellence.

Now users of handheld 3½-digit multimeters are also getting to know us because of the wide acceptance of the 8020A Analyst, the world's best-selling handheld DMM, and the 8022A Troubleshooter, our basic-performance multimeter.

With the addition of the 8024A Investigator to the Fluke low-cost DMM line, we now offer three choices with three distinct levels of performance: basic voltage/current/resistance functions; the added convenience of conductance for high resistance measurements to 10,000 Megohms; or all these functions plus K-type thermocouple compatibility, peak hold and a logic level/continuity detector.

As a product family, the Troubleshooter, Analyst and Investigator offer a unique combination of electrical performance, mechanical ruggedness and environmental endurance to users who want the convenience of a handheld DMM without sacrificing the accuracy and performance of a benchtop instrument.



Simple, straightforward and easy on the eyes.

We've always thought a handheld DMM should actually *work* like one – that is, the size and shape and placement of controls should allow true one-hand operation. Fluke handheld DMM's are strikingly simple in design with uncluttered front panels where function and range combinations are clearly defined by color coding. A single row of eight trouble-free push-buttons replaces the awkward rotary switches still offered on other multimeters.

The crisp, razor-sharp 3½-digit LCD readout in these three instruments features a wide viewing angle that you can see in bright sunshine or low ambient light.

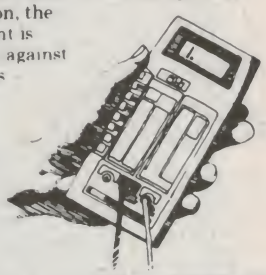
Graduated with honors from the school of hard knocks.

All Fluke handheld DMM's feature tough, lightweight cases that stand up to the abuses of life in the field. Sturdy internal construction surrounded by a high-impact, flame-retardant shell make these units virtually indestructible. And all meet severe shock/vibration tests.

The shockir g truth about overloading.

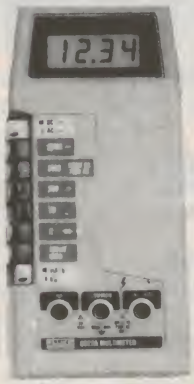
Like all Fluke Multimeters, our handheld DMM's are equipped with extensive internal protection against overloads and operator errors. Don't worry if you accidentally plug the test leads of your Fluke DMM into a wall outlet while the instrument is in the resistance function. The same test could destroy a multimeter with lesser defenses. But a Fluke DMM comes through with flying colors. A simple case of survival of the fittest.

Our DMM's can stand up to this kind of punishment because a substantial portion of their components are devoted exclusively to reliability. The 8020A, 8022A and 8024A can withstand 500V on resistance ranges, and 1000V dc and 750 rms ac on all voltage ranges. In addition, the instrument is protected against transients to 6 kV.



FLUKE®

The 8022A Trouble shooter.



Model 8022A: The Troubleshooter

- Six functions
  dc voltage
  ac voltage
  dc current
  ac current
  resistance
  diode test
- 3½-digit resolution
- 0.25% basic dc accuracy
- LCD display
- Overload protection
- Safety-designed test leads

The 8024A Investigator.

Model 8024A: The Investigator

- Nine functions
  dc voltage
  ac voltage
  dc current
  ac current
  resistance
  diode test
  conductance (1/R)
  logic level and continuity detect
  temperature (K-type thermocouple)
- Peak hold on voltage and current functions
- Selectable audible indicator for continuity or level detection
- 3½-digit resolution
- 0.1% basic dc accuracy
- LCD display
- Overload protection
- Safety-designed test leads

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Brisbane : (07) 229-3161
Perth : (09) 398-3362

TV's bionic superman a fake!

... As if you didn't already know. However, with the aid of electronically operated limbs, a bionic man with ordinary human strength is well within possibility.

A small team of electronics technicians at the Fidelity laboratories in Miami specialises in designing and building electronically controlled arms and hands for amputees.

They are also working on a voice-controlled environmental centre for quadriplegics, in which a handicapped or non-mobile person could turn on the TV, change channels, raise and lower the volume, answer the telephone, make calls through the operator, open the door after first screening the visitor through a closed circuit TV and intercom, turn lights on and off, and even make coffee — all through voice-controlled electronic equipment.

Myonic hands and arms are the team's speciality, 'myonic' being similar to the famous bionic, except that in a myonic arm the electrodes are mounted over the muscles outside the arm, whereas in bionics the electrodes are surgically implanted.

The process starts with a cast being made of the amputee's stump. To this are fitted the electrodes, one set on one side of the cast and one set on the other. These electrodes are carefully located so they will be in contact with a muscle in the arm.

Although the hand has been amputated, the brain can still send signals to the muscles; these pulses can be sensed by the electrodes, and using a battery power pack and a tiny amplifier they are amplified to signals big enough to operate an electrical hand.

In the case of an amputee losing a whole arm, small electrical switches are fitted to a harness that straps on to his back. The shrug of one shoulder will raise and lower the arm, a shrug of the other will open and close the hand. The next step is to incorporate a microprocessor into the circuit to enable the hand to perform many more functions.

According to Henry Sylwestrzak, one of the research workers, "By using a code system the amputee would be able to twist his wrist as well as open and close the hand. There is really no limit to what we will be able to do eventually. It's just a matter of time. We have all the technology now."

So with the help of a myonic hand and arm an amputee may be able to leaf through a book or even drink a can of beer — but he won't become a superman.

"Even if you fitted somebody with a pair of super-strong bionic arms he wouldn't be able to become a superman," said Henry. "If he tried to pull a door off its hinges with his super arms he would pull his human shoulder out of its socket. And if he tried to pick up a heavy weight that was too big for his body, even though his super arms may be able to cope, his back wouldn't — it would simply break ... There won't be a super bionic man. The limbs have to be graded to the performance ability of the human limbs."

However, apparently NASA, without having built a super man, have created a super suit.

Like Superman, when you don the suit you become ten times more powerful. The suit has motorised arms and legs, operated by electrodes attached to the man's body which pick up the signals from the human muscles. When you bend to pick up a heavy weight the electric motors take over, your arm is carried along by the suit's arm, and you can lift a weight ten times heavier than a man alone could. The human inside the suit simply gives the orders with his muscles and the suit does the work.

NASA developed the suit for spacemen working in outer space, but the technology could no doubt eventually be passed into industry. Imagine a 'superman' on a building site moving enormous rocks or hoisting steel beams and holding them up while others bolted them in place! And in a rescue operation a man in a

super suit could lift machinery, rubble, etc. off trapped victims.

Fidelity, however, leave the superman side of things to NASA. Their latest research area is rather to develop a sensory system for the fingers of their myonic and bionic arms, so that an amputee will to some degree regain a sense of touch.

The idea is to fit strain gauges in the fingers of the myonic hands, which, when touched, will create a small voltage that is sent back to the muscle. This will induce the sensation of feeling in the hands — just one more step in the fast-growing technology that is improving life for amputees and the handicapped.

Dennis Lingane

IBM eliminates distortion in optical fibres

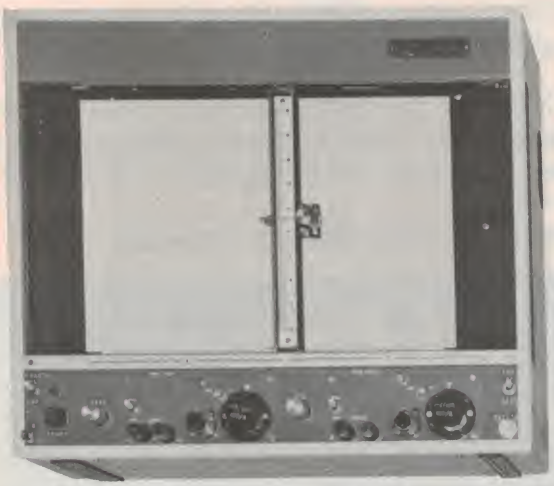
A new technique developed by IBM can exactly compensate for the broadening of optical pulses caused by dispersion differences in the speed of light of different frequencies in the glass fibres.

It exploits work done some years ago at IBM on the compression of short laser pulses in alkali metal vapours at frequencies close to an atomic resonance frequency. In this situation the metal vapour is extremely dispersive, but its dispersion is of the opposite sign to that in glass. That is, in glass the longer wavelengths travel faster than the shorter ones, while in the metal vapours the opposite is true.

The effect in metal vapours is so strong that in the IBM experiments a 50 cm cell exactly compensated for dispersion of some 300 m of optical fibre. By providing for multiple passes through the cell, a cell of modest size could compress pulses travelling over kilometres of fibre.

Riken Denshi general purpose X-Y recorder

The Riken Denshi Model F-3E X-Y recorder features rugged construction, high stability and simplicity of controls, making it suitable for most production and plant testing situations.



A high-efficiency damping system on both axes is achieved by a servo-motor generator circuit, which feeds back a rate signal to the servo amplifier and combines with the usual position feedback signal to produce a pen motion which is rapid yet offers high resolution.

The F-3E may be mounted horizontally or vertically, and its specifications include 250 x 180 mm chart, 0.5 s response, +/−0.1% resolution, accuracy +/−0.3%, linearity +/−0.2%.

For further information contact John Morris Scientific Pty Ltd, P.O. Box 80, Chatswood NSW 2067, (02)407-0206; 21 Stud Rd, Bayswater Vic. 3153, (03)720-2311; 50 Campbell St, Bowen Hills Qld. 4006; 29 Stephen St, Norwood SA 5067; 12 Aberdeen St, Perth WA 6000.

Halley go home — NASA can't afford you

US President Reagan's decision to cut NASA's budget by US$241 million for the year beginning October 1981 has meant a severe cutback in NASA's planned operations.

There will be no US probe to rendezvous with Halley's Comet in 1985; the VOIR project to provide detailed mapping of the surface of Venus will be deferred, as will the launch of an earth satellite carrying instruments to measure the gamma ray emission from distant objects; and the provision of a US$100 million specialised computer for advanced aircraft design for NASA's Ames Research Centre at Moffett Field has been put off indefinitely.

Space agency officials maintain, however, that they will continue to carry out a "vigorous" programme for the exploration of the solar system in spite of these cuts. NASA expects to keep its option to build a fifth Space Shuttle in addition to the four already authorised, and work on the Space Telescope will continue.

Equipment and staff required to receive the signals from Voyager 2 and to process the data will be fully maintained during its encounters with Saturn, Uranus and Neptune (see ETI, April 1981), and the modified Galileo mission to Jupiter involving the launch of an Orbiter and an atmospheric probe in 1985 will also be preserved (see ETI, October 1980 and March 1981).

In 1981 NASA plans to launch ten satellites from expendable launch vehicles from the Eastern Space and Missile Centre, Cape Canaveral, and a further five from the Western Space and Missile Centre at Vandenburg Air Force Base in California. However, thirteen of these fifteen missions will be for US government agencies and commercial companies, and NASA will be fully reimbursed for the cost of the launch and related services.

The two NASA-funded scientific payloads are the Dynamic Explorer, set for a July launch by a Delta rocket, and the Solar Mesospheric Explorer, scheduled for launching in September, also from a Delta rocket.

The thirteen cost-reimbursable launches comprise: two weather satellites for the National Oceanic and Atmospheric Administration, three missions for the Department of Defence, and eight geosynchronous communications satellites. These last will be four launches of INTELSAT vehicles for international telecommunications, two launches for RCA, one for Satellite Business Systems (which provides business communications across the USA), and one launch for the Comsat General Corporation.

In addition, the success of the two-day Space Shuttle flight in April has led NASA to plan at least one further launch of this reusable vehicle in 1981. Unfortunately the unexpectedly high cost of the space Shuttle (which is of considerable military significance) has resulted in a noticeable reduction of NASA's budget in purely scientific work.

Brian Dance

NEWS digest

Low-cost transient recorder

Applied Measurement Aust. Pty Ltd has recently been appointed Australian agent for Epic Instruments of USA. Featured in Epic's range is the Wavesaver, a device for capturing analogue signals and displaying them on a CRO or plotter.

The incoming signal is converted to digital information and stored in memory at speeds up to 2 uS/sample. From here, the stored data can either be output directly to computer or converted back to analogue for display on a CRO at 10 ms repetition, or plotted over 20 seconds.

A major advantage of this type of recording is that data either before or after the trigger point can be captured.

Applications include power line transient monitoring, explosion recording, shock and vibration testing, chemical kinetics, medical research etc.

Whilst the Wavesaver is by no means the first instrument of its type to become available, Applied Measurement claim it represents a big breakthrough in cost.

For further information contact Applied Measurement Aust. Pty Ltd, 47a Karnak Road, Ashburton Vic 3147. (03) 25-8844.

New digital panel meters

A new range of 3½ and 4½-digit DPMs has been released by Xebec, represented here by Alfatron of Victoria.

The XE-1000 series DPMs are of modular construction and offer high reliability, light weight and easy installation.

Compact designs can be achieved as most of the units measure only 25 mm or 35.5 mm in depth.

All models operate from a single 5 V supply and feature auto-zero, over-range display, sample and hold circuitry, automatic polarity detection and a single interface connector situated at the rear of each unit.

Optional features such as digital output, use of differential input signals and low power LCDs are available in the new range.

For more details, contact Alfatron Pty Ltd, 1761 Ferntree Gully Rd, Ferntree Gully Vic 3156. (03)758-9551.

Computer programs on shortwave!

Radio Nederland's External Service broadcasts a weekly communications magazine programme, 'Media Network', in English to a world-wide audience on a range of frequencies.

On Thursday, September 10 1981, the subject of the programme is to be microcomputing, and included will be a short computer program broadcast in machine readable form over the air — quite an innovation!

Provided signal strength is sufficient in the listener's area, it is hoped that the computer program may be recorded on to cassette tape and played back into a home computer. Preliminary experiments have indicated that the system should work, but the purpose of the experiment on September 10 is to gauge whether atmospheric noise is low enough in most of the target areas. If successful, the idea might be repeated on a regular basis.

Radio Nederland has two relay stations, in Bonaire in the Caribbean and in Madagascar, which should ensure a strong signal in the major target areas.

Three computer programs will be transmitted, to be compatible with Tandy Radio Shack, Apple, and Commodore PET microcomputers. They will go on the air at the following times and frequencies:

GMT	SW Frequency (kHz)	Target area
07.47	9770, 9715	Australasia
08.47	9715	Australasia
14.47	11735, 15560, 21480	South-east Asia

The time shown is the beginning of the 'Media Network' programme, which runs for 30 minutes. The programme regularly looks at developments in the broadcasting world, both from a technical and programming viewpoint, reviews equipment, transmits reports from correspondents throughout the world, etc. Its main response is via listeners' letters and phone calls, and the nine editions of the programme reach a wide audience.

Listeners to the September 10 broadcast are encouraged to try out the computer program and write in to Media Network reporting their results, etc. Write to: Computer Experiment, Media Network, Radio Nederland, P.O. Box 222, 1200 JG Hilversum, Holland.

THE ETI-477 MOSFET AMP IS NOT UNSTABLE

. . . If you build it the way we described, that is. However, some readers have reported difficulties with the amplifier going into high frequency oscillation. There are two reasons for this. If capacitor C9 (220n greencap) has a high self-inductance it will not look like a capacitor, the amplifier output will be unloaded at high frequencies and oscillation will result. We found 'Elna' 630 V greencaps have a low inductance and the amp is not unstable using them.

Secondly, if resistors R25 and R27 have more self-inductance than the 'Noble' types we used, then the output stage may be unstable. There are two cures for this one. Either replace R25 and R27 with Noble types or connect a 47n greencap between the sources of Q9 and Q11. This is best done on the copper side of the board, mounting the capacitor between the two pads where the leads of each resistor go to the sources of Q9 and Q11.

THE 100% SOLUTION FOR THE 50% PRICE*

We at Magmedia believe that VERBATIM'S new Datalife 8″ and 5″ Floppy Diskettes — now made here, in *Australia!* — are the best in the world.

With 7 shielding improvements, 100% TESTED, 100% CERTIFIED, 100% WARRANTED, we think you'll believe it too — buy a box — you've got nothing to lose but your diskette problems.

Verbatim flexible diskettes now have 7 data shielding improvements that will deliver a longer lifetime of trouble-free data recording storage and retrieval than ever before possible.

SATISFACTION GUARANTEED

	NORMAL PRICE	DISCOUNT PRICE
8″ Hard/Soft Sectored — Single Sided, Single Density	$4.50	**$2.25**
8″ Hard/Soft Sectored — Single Sided, Single Density — Critically Tested.	$5.00	$2.50
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Peninsula to be antenna for ultra-low frequencies?

Transmissions at ultra-low frequencies (perhaps 10 Hz to 0.005 Hz) have aroused interest because of their possible military applications.

One such application could be communication with submerged submarines, but workers at Stanford University are more interested in the radiation at such frequencies, which seems to come from outer parts of the radiation belts of the earth. For either type of application at such very low frequencies the main requirement is a huge transmitting or receiving antenna, since the wavelength is about the distance of the moon from the earth.

Initial work by Fraser-Smith was carried out using a small peninsula near Cape Cod, Massachusetts, with 300 m of wire across the neck of the peninsula, each end of the wire being attached to copper sheets 0.45 m^2 immersed in the sea water. As sea water conducts electricity quite well, the current is forced to flow around the peninsula in an approximately elliptical path, which defines the current loop. A receiver at the middle of the wire picked up signals from space.

Further tests were carried out using aluminium wire stretched across the same peninsula and attached to large galvanised iron pipe sections some 180 m apart. The low frequency alternating current was produced through the use of four automobile starter relays connected to two 12 V batteries. It was found that an aircraft flying at heights between 160 m and 320 m above the peninsula could detect the signals.

The team now hope to repeat the experiment using a far larger peninsula, about the size of Cape Cod. The construction of a conventional antenna of the required dimensions is out of the question owing to the huge cost which would be involved. The recent work was funded by the National Science Foundation with the help of the US Navy, which is very interested in the possible use of ultra-low frequency waves as a possible future way of communicating with submarines.

Fraser-Smith is especially interested in the slow warbling currents from space, which he detects with a huge antenna by recording them onto tape and playing them back at a much faster tape speed. Although there is a well-developed theory for the origin of these pulsations, the theory has not yet been tested. Fraser-Smith is interested in the possibility of using a large enough peninsula as an antenna so as to be able to transmit ultra-low frequency signals to the radiation belts on nights when the warbling currents are absent, in order to see if the particles in the belts interact with the transmitted signals in the way predicted by the theory.

For this work a high-power system would need to be situated in a peninsula which has a low population density (since the high field could generate some electric shocks to bathers!). The Russians are reported as having used a peninsula antenna to generate an ultra-low frequency magnetic field which could be measured some 750 km away, but it is thought they employed magnetohydrodynamic portable generators.

Although ultra-low frequency waves can penetrate deeply into the oceans, communications data rates would be very limited.

Brian Dance

HP fibre optic link

The new Hewlett-Packard HFBR-0500 snap-in fibre optic link is TTL compatible, fully guaranteed, and available for only $59.95 (NZ$66).

It is supplied, in kit form and as discrete units, with all the elements of the link including transmitter, LSTTL/TTL compatible receiver, 1 mm core diameter plastic fibre in bulk or terminated lengths, connectors and a polishing kit.

It can be used for low-cost, short length inter- or intra-system data links to solve common mode or high-voltage isolation problems, and may also be useful in educational institutions due to its low-cost cable and connectors, ease of interfacing with other circuits and easily viewed light output from the cable.

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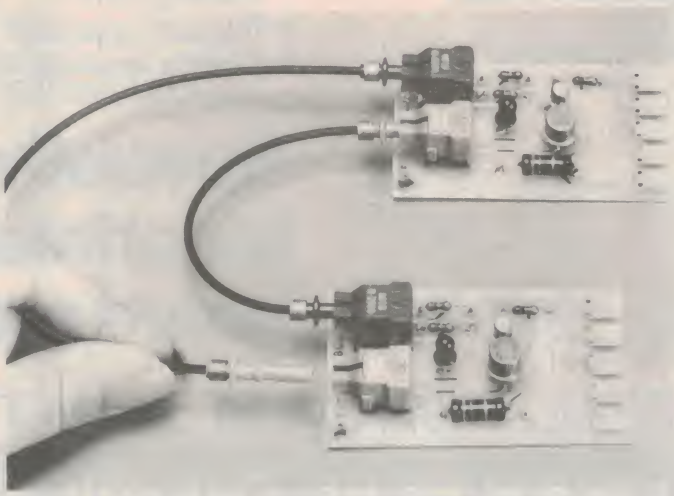

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The range is available in standard, short, flat and straight-flat toggle, with straight, right-angled, vertical and straight-support bracket terminations. Other features include:

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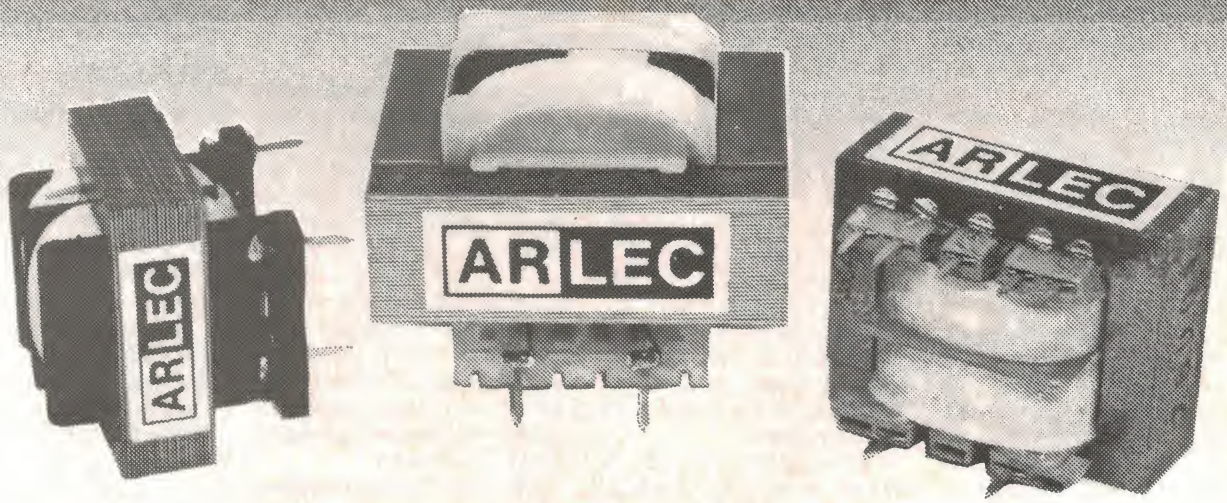

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Electronic distance measurement for industrial and scientific applications

This new distance meter features a transducer mode in which it measures the distance to a moving target nine times per second for output to a computer or other controller.

David E. Smith

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UNTIL NOW, electronic distance measurement (EDM) has mainly benefited the land surveyor. EDM instruments with the ability to measure several kilometres with millimetre resolution have vastly improved the surveyor's efficiency, productivity, and measurement reliability[1]. These benefits are now made available to the industrial and scientific user by a new Hewlett-Packard EDM instrument, Model 3850A Industrial Distance Meter (Figure 1).

The 3850A measures distance to a target optoelectronically, using an infrared light beam. It measures the one-dimensional positions not only of stationary targets but also of moving targets with velocities up to 1600 metres per second. The instrument supplies elapsed time in addition to position data at nine measurements per second. When it is interfaced with a computer, noncontact measurements of the target's position can be made, and the target's velocity and acceleration can be computed. The 3850A's wide dynamic range makes measurement of the position and velocity of an aeroplane 8000 metres away as practical as controlling the position of an industrial crane to a resolution of 0.001 metre.

Electronic distance measurement technique

The 3850A uses phase measurement of a modulated infrared beam to measure distance to a retroreflector target. Unlike interferometric distance measurement, which detects changes in a target's position[2], the phase measurement technique provides absolute distance measurements, independent of optical path interruptions.

The infrared light beam is modulated at one of three frequencies: 15 MHz, 375 kHz or 3.75 kHz. These frequencies have corresponding modulation wavelengths of 20 metres, 800 metres, and 80 kilometres respectively. Since the light beam is transmitted to the retroreflector and back, the effective modulation wavelengths, λ_e, are half the actual wavelengths. As the retroreflector moves from 0 to λ_e metres from the 3850A, the phase of the received signal with respect to the transmitted signal varies linearly from 0 to 2π radians. For multiples of λ_e, phase measurements roll over, varying from 0 to 2π radians as the retroflector moves from $n\lambda_e$ to $(n+1)\lambda_e$, where ▶

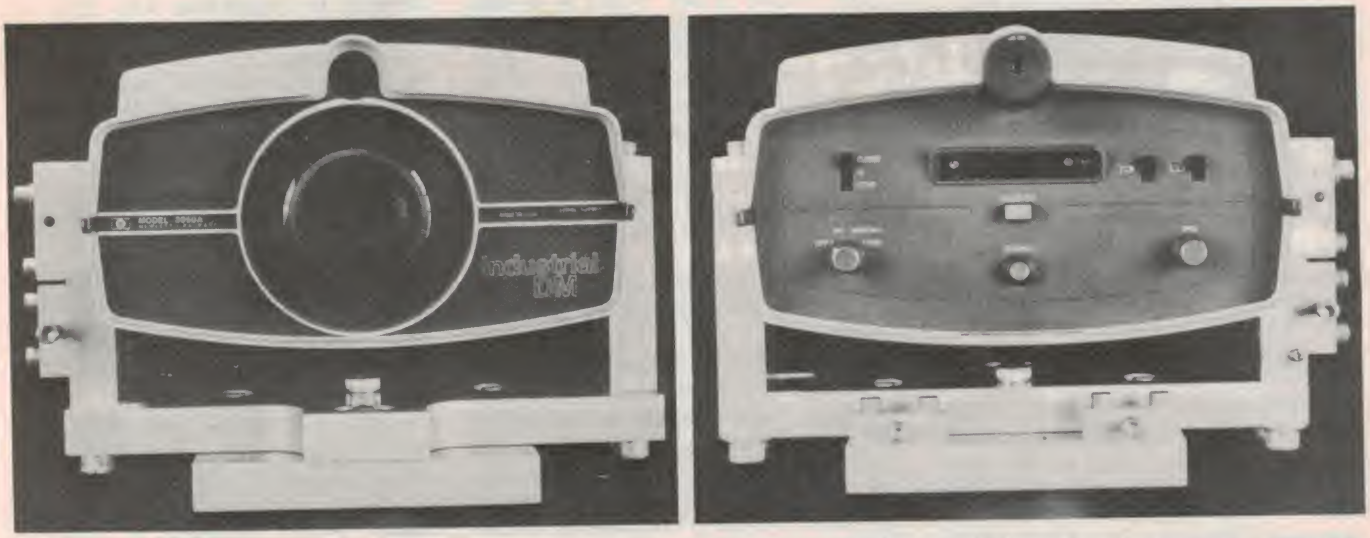

Figure 1. **Model 3850A Industrial Distance Meter measures distances to stationary or moving targets using rugged field-proven technology. Its input/output capabilities include extended remote programmability and data output at nine measurements per second.**

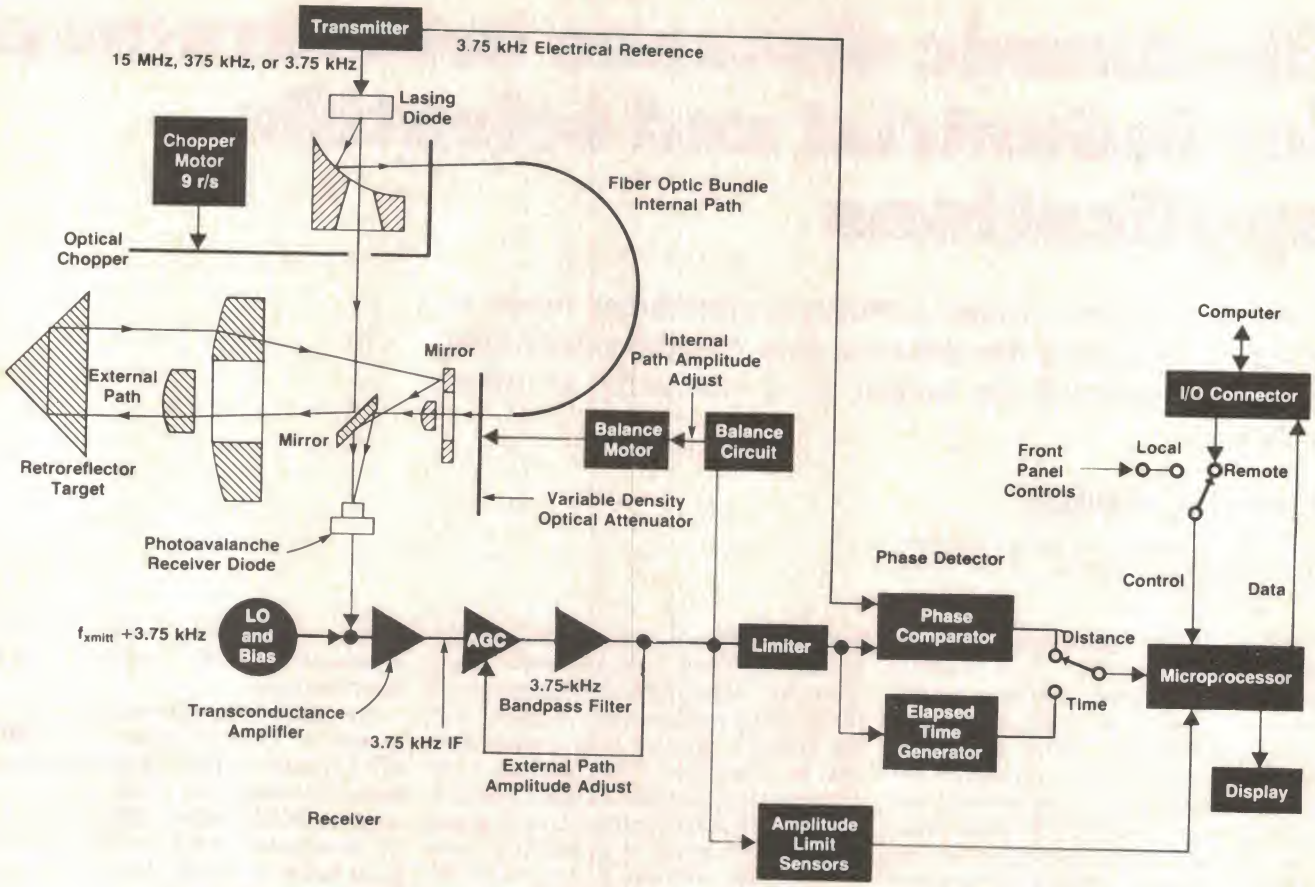

Figure 2. **Simplified block diagram of Model 3850A Industrial Distance Meter. The phase difference between the external and internal paths represents the distance to the target. The microprocessor performs computation, control, and input/output functions.**

n = 1.2, ... To obtain an absolute distance measurement the 3850A measures the phase of each modulation frequency and merges the three readings into one.

The 3850A measures phase with a resolution of 0.6 milliradians (0.04 degree). This high resolution dictates maximum suppression of any drift in the instrument's electronics. To suppress drift, the 3850A employs two optical paths, generated by splitting the infrared light beam into an internal fixed path and a variable-distance external path. Any phase shift caused by the electronics is common to both paths. The 3850A measures the phase of the internal path and subtracts this reading from each external path reading. Thus the common-mode phase drift is subtracted out.

What's inside

All measurement signals in the 3850A start at the transmitter (see block diagram, Figure 2). A temperature-compensated crystal oscillator (TCXO) establishes the instrument's reference transmit frequency of 14 987 090 Hz. This frequency determines the overall distance scale factor, and its stability determines the 3850A's accuracy at long distances. The TCXO's output is stable to within ±1 ppm over the 3850A's operating temperature range of 0°C to +55°C. Maximum drift is <±1 ppm per year, guaranteeing long-term accurate operation.

The output of the TCXO is divided down to produce the other two transmit frequencies, 375 kHz and 3.75 kHz. Under processor control, these signals are multiplexed to the lasing diode driver. The lasing diode assembly (Figure 3) is a proprietary device developed for HP distance measuring instruments. The diode produces approximately 1.4 mW of infrared optical power at a wavelength of 840 nm. This output is stabilised by an optical feedback loop built into the diode assembly.

The output of the lasing diode is split into external and internal optical paths using an annular ellipsoidal reflector. The centre of the diode's diverging beam passes through a hole in the reflector to become the external path. The rest of the diode's output is focused by the reflector's ellipsoidal surface onto the end of a fibre optic bundle to become the internal path. An optical chopper rotating at nine revolutions per second continuously alternates between paths for processing by the receiver.

During the external path time (when light to the fibre optic bundle is blocked by the chopper) the diode's beam is reflected by a 45° mirror and passes through the transmitter lens. This lens collimates the transmit beam, reducing its divergence to within 0.9 milliradians. The maximum optical power of this transmit beam is 60 μW, well within safe limits for the human eye.

The transmit beam is reflected by a retroreflector attached to the target. The returning beam passes through the receiver lens and is reflected by an annular mirror and the back of the 45° mirror onto the receiver diode. Depending on the distance to the target and atmospheric conditions, the amplitude of the optical signal at the diode can vary from 60 nW to 20 pW.

During the internal path time (when light to the transmitter optics is blocked by the chopper) light travels through the fibre optic bundle. The bundle's output passes through a variable-density rotary attenuator that can be rotated by a motor to equalise the internal and external path optical signal

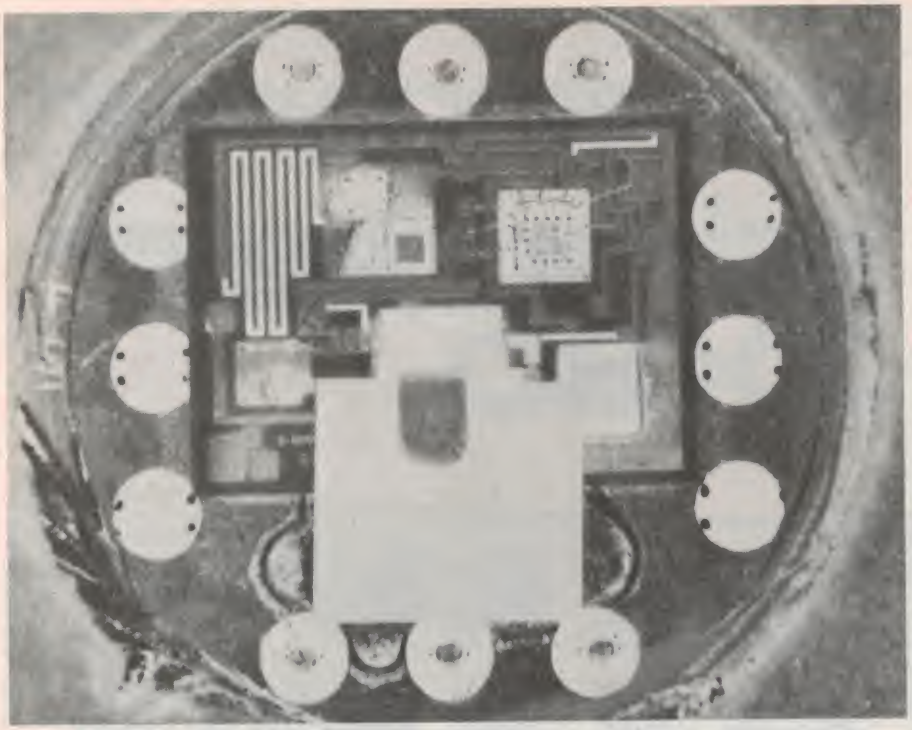

Figure 3. **The optical source in the 3850A is a proprietary HP solid-state lasing diode. An on-board optical feedback loop stabilises the output power.**

amplitudes. The equalised output from the attenuator is then focused by the optics onto the receiver diode by reflecting off the back of the 45° mirror.

To recap, at the receiver diode we have two optical signals that alternate at 55.5 ms intervals. One signal represents the length of the external, variable path, while the other signal represents the length of the fixed internal path.

The purpose of the photoavalanche receiver diode is threefold. First, the diode converts the optical signal into an electrical current. Second, by means of photoavalanche action the diode amplifies this current by a factor of 35. Third, an electrical current generated by local oscillators is applied to the diode to mix the 15 MHz and 375 kHz signals down to the receiver's 3.75 kHz intermediate frequency. Since phase information is preserved in the mixing process, the 3850A's phase detector can operate at a low frequency to produce high-resolution results.

The 3.75 kHz current at the receiver diode's output is converted by a transconductance amplifier to a proportional voltage. This is applied to an AGC stage with a dynamic range of 80 dB. The gain of the AGC stage is adjusted to compensate for external path amplitude variance. The output of the AGC stage passes through a four-pole active bandpass filter with a Q of 12.5. The resulting 3.75 kHz sine wave signal is then processed by the limiter.

The amplitude of the external path signal may vary greatly. The heat shimmer that a person observes on a warm day distorts not only visible light but also infrared. These perturbations of the atmospheric index of refraction tend to disturb the transmit beam, sometimes deflecting it off the target at long distances. This deflection results in up to 100% amplitude modulation of the received signal. To avoid processing data that is outside the limiter's 23 dB dynamic range, amplitude sensors monitor the receiver's output. These sensors tell the processor when the signal is in-bounds. The sensors also monitor the receiver output amplitude on the internal path. This information is used by the balance circuit to equalise the internal path amplitude by means of a motor-driven variable-density attenuator.

The limiter acts as a precision zero-crossing detector to 'square up' the receiver's output. This square wave is sent on to the phase detector.

The phase detector has several functions. It compares the phase of a 3.75 kHz electrical reference from the transmitter with the phase of the internal and external signals. The average of 50 phase comparisons on each path is transferred to the processor, which takes the difference between successive internal and external comparisons. This difference eliminates common-mode phase drifts and yields the true distance to the target. The phase detector also generates time data for use with moving targets. A time mark signal is issued during the 50 phase comparisons on the external path. The leading edge of this mark indicates precisely when the instrument is measuring a stationary or moving target's position. Also, the elapsed time between successive external path comparisons is accumulated and transferred to the processor.

The processor, like the phase detector, is a multifunctional block. It accepts programming inputs from either the front panel or the remote I/O connector. All key signal timing in the instrument is processor controlled. Moreover, the processor processes distance information differently depending upon which operational mode is selected.

In the distance instrument (DI) mode the processor sequentially averages measurements in all three resolution functions (i.e: using all three modulation frequencies). It takes the three averages, merges them into one number representing the absolute distance, and corrects for instrument offset and atmospheric scale factor. The resulting number goes either to the display or the I/O connector.

In the distance transducer (DT) mode the processor outputs raw distance, elapsed time, and status information directly to the I/O connector. It allows the external computer to select either raw distance or signal strength using any of the three resolution functions. The processor also generates status digits containing information from the amplitude sensors at the receiver's output.

Extended remote programmability

Although digital output is not unique to the 3850A, the new instrument is the first HP distance meter to be remotely programmable. Not only are the 3850A's major front-panel controls programmable, but the powerful distance transducer mode has been added for measuring moving targets. In this mode the 3850A outputs 14 digits of information about the target to a computer at a rate of nine measurements per second. Four of these digits represent the target's position. Five digits represent the elapsed time since the previous measurement and may be used by the computer to calculate target velocity and acceleration. The last five digits represent the mode and function programmed and the status of the optical path. The optical path status digit can warn the computer immediately of an obstruction in the optical path, a necessity if the 3850A is used as the position transducer in a closed-loop ▶

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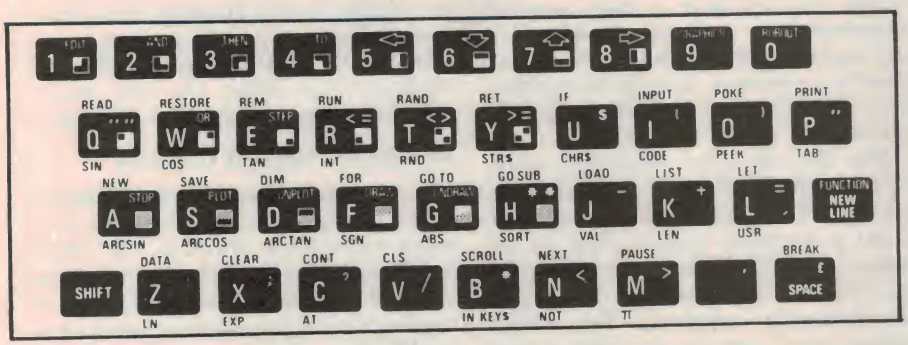

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position control system. The 3850A may be interfaced with computers using the 38001A HP-IB Distance Meter Interface.

The basic measurement system for static and dynamic monitoring applications consists of the 3850A, the 38001A, a 9825S computer and a 62012E power supply. Figure 4 shows the first three of these. Additional HP-IB peripherals such as the 59501A isolated digital-to-analogue converter and the 59306A relay actuator are available to expand the basic system for closed-loop position control applications.

Operational modes

The 3850A may be programmed by the computer to operate in one of three different modes: the distance instrument (DI) mode, the distance transducer (DT) mode, or the self-test mode. The DI mode is used for absolute position measurements on stationary targets. Functions in this mode may be selected either locally by means of the 3850A's front-panel controls or remotely via the I/O connector. Thus a measurement may be initiated either from the 3850A's front-panel MEASURE button or remotely from the computer. Once initiated, the measurement proceeds under complete control of the instrument's microprocessor. After a minimum of nine seconds, the microprocessor outputs a distance measurement accurate to within ±(5 mm + 1 mm/k) mean square error to either the 3850A's display or the computer. This measurement is a composite of at least 24 raw distance measurements using all three resolution functions.

Another function remotely programmable in DI mode is the environmental correction/return signal strength function. This function allows the user to insert a correction factor for the variation of the speed of light with atmospheric temperature and pressure. This function also allows the operator to observe the strength of the signal being received from the target.

The DI mode is well suited for applications such as surveying where measurement speed is not crucial, targets are stationary, and measurement simplicity is paramount.

Measurement of moving targets requires a fast, flexible operating mode. The distance transducer mode gives the 3850A the capabilities needed to measure the dynamics of a moving target. As mentioned previously, this mode features a high-speed data rate of nine measurements per second. Each measurement consists of four digits of raw distance, five digits of elapsed time between successive measurements, and

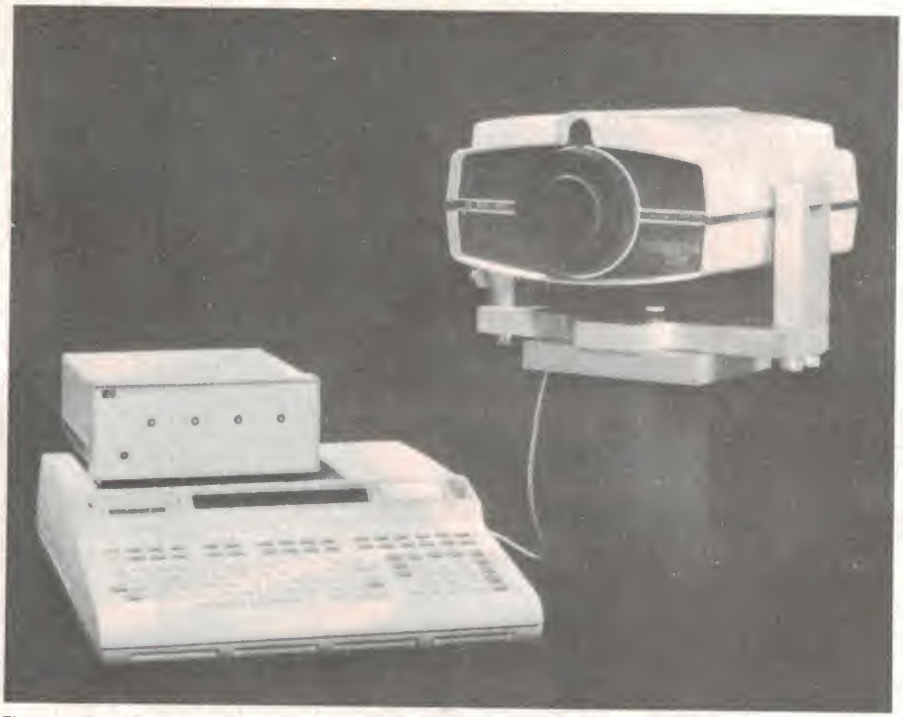

Figure 4. **This basic dynamic measurement system can be used for measurements on moving or static targets. For industrial position control applications a digital-to-analogue converter or relay actuator may be added.**

five digits of instrument status information. The computer may select distance information using any of the three resolution functions: high (1 mm), medium (40 mm), or low (4 m). In the highest-resolution function the positional accuracy of ±(5 mm + 1mm/km) mean square error for target velocities up to 40 metres per second is the same as stationary-target accuracies.

The third operational mode is the self-test mode. The 3850A's integrity may be verified using this mode. When self-test is initiated, the processor executes an internal test to confirm that the distance measuring system is operational. If a failure occurs, one of 32 failure codes is returned to the computer. These codes allow the user to pinpoint instrument failures.

Measuring moving targets

While measurement of a stationary target requires only a static position measurement, measurement of a moving target demands a distance-plus-time measurement. The 3850A specifies this time-distance coordinate pair in two ways.

The first dynamic method of operation is the time sync method. In this case the 3850A's elapsed timer is synchronised to a master system clock by the system controller. The controller resets the elapsed timer at the start of a measurement sequence. The 3850A subsequently outputs the elapsed time between the reset point and the first distance measurement, the time between the first measurement and the second, and so on. Thus, in spite of the fact that the 3850A measures distance asynchronously, the system controller can determine when each measurement occurs in real time.

The second dynamic method of operation is the triggered sync method. In this case the 3850A outputs a time mark signal whose leading edge coincides with the point in time when the distance measurement is perceived to have occurred. Each distance reading that the 3850A outputs to the computer is composed of the average of 50 phase comparisons at 3.75 kHz on the external path minus the average of 50 phase comparisons on the internal path. Thus the 3850A actually determines the average target position over a 13 ms aperture time, i.e: 50x(1/3750)s. One might conclude that the leading edge of the time mark should occur at the centre of this aperture time. However, because of an interesting combination of the Doppler effect and receiver filter delay, the time mark's position is predictably skewed in time.

Dynamic target effects

Let us now determine what effect a moving target has on the 3850A. In its highest-resolution function, the 3850A transmits to the target a signal whose effective modulation wavelength is 10 metres. This corresponds to an effective modulation frequency of ≈30 MHz. Now assume that the target is moving

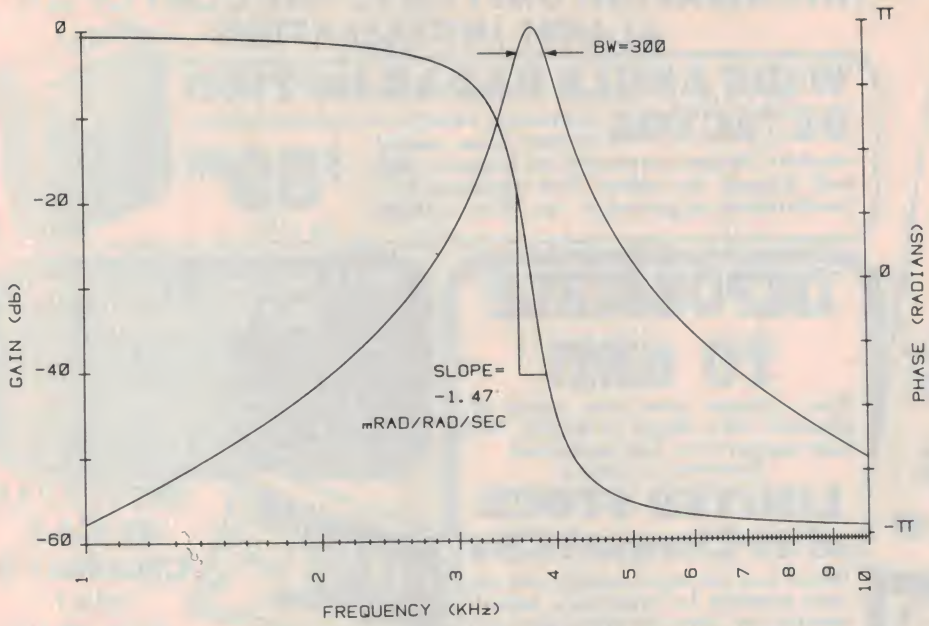

Figure 5. **Amplitude and phase characteristics of the 3850A receiver's four-pole IF bandpass filter. The filter delay results in an error proportional to target velocity. This error is compensated internally so the 3850A's distance measurement accuracy is independent of target velocity.**

towards the 3850A at a constant velocity of 40 metres/second. Because of Doppler shift, the frequency perceived by the receiver is approximately:

$$f_{rec} \approx \left(\frac{c}{c-\mu_s}\right) f_{trans},$$

where c is the speed of light and μ_s is the target's velocity. Thus:

$$f_{rec} \approx 30\ \text{MHz} + 4\ \text{Hz}$$

and after mixing down:

$$f_{1F} \approx 3.75\ \text{kHz} - 4\ \text{Hz}$$

Although this Doppler shift of 4 Hz does not appear significant, a considerable error is observed when the signal is passed through the receiver's four-pole bandpass filter. At 3.75 kHz ±4 Hz this filter exhibits a linear rate of change of phase lag with frequency of 1.47 milliradian/(rad/s), as shown in Figure 5. Since 0.63 milliradian of phase shift represents 1 millimetre of distance, the 4 Hz Doppler shift results in a position error of:

$$X_{Doppler} = 2\pi f_{Doppler} \cdot \left(\frac{1.47\ \text{mrad}}{\text{rad/s}}\right)\left(\frac{1\ \text{mm}}{0.63\ \text{mrad}}\right)$$

$$= 59\ \text{millimetres.}$$

This result means that for a target approaching the instrument at 40 metres per second, the 3850A will perceive the target to be 59 millimetres farther away than it actually is. Similarly, for a target moving away from the 3850A at 40 metres/second, the instrument observes the target to be 59 mm closer than it is. Must the user account for this error, or can the 3850A automatically correct for it?

The Doppler frequency shift produces a position error equal to approximately $(1.47\mu_s)$ mm if we assume that the time of the average measurement is the centre of the aperture time. To compensate for this, the 3850A time mark signal has been moved 1.47 ms ahead of the centre of the aperture time. For the target approaching the instrument at μ_s metres/second, its position at the adjusted time mark signal is (μ_s metres/second).(1.47 ms) or $(1.47\mu_s)$ mm farther away than the position at the centre of the aperture time. Thus the reading that the 3850A produces now coincides precisely with the adjusted time mark signal. Similarly, the same situation exists for receding targets and varying velocities. Thus the 3850A is able to measure the position of a moving target to an accuracy of ±(5 mm + 1 mm/km) mean square error with no user velocity correction factor.

Dynamic accuracy testing

To prove the dynamic positional accuracy of the 3850A, two special test instruments have been developed. One of these, the dynamic target simulator (DTS), has been used to observe hundreds of thousands of data points for position accuracy. An example is shown in Figure 6. Each data point represents the error between the position of the DTS target at the leading edge of the time mark signal and the 3850A's position measurement. This error is plotted against the target's velocity and a first-order curve is fitted to the data. The extremely small value of the proportionality coefficient is an indication of the 3850A's velocity independence. ▶

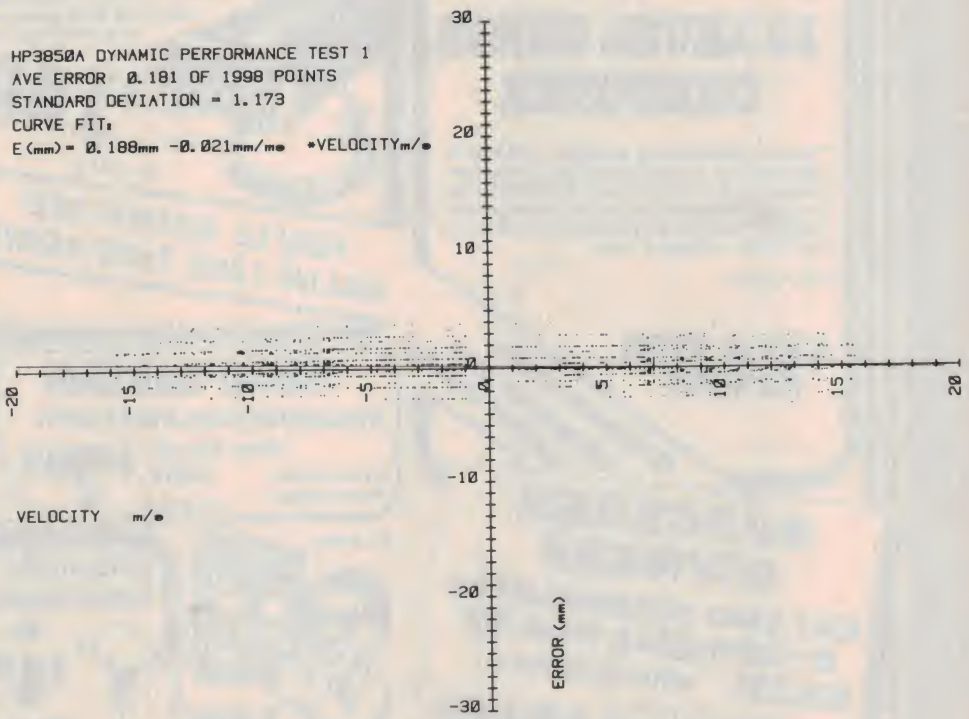

Figure 6. **Typical 3850A position accuracy for moving targets. The curve is the average of 1998 data points for one 3850A as measured by a special test instrument, the Dynamic Target Simulator.**

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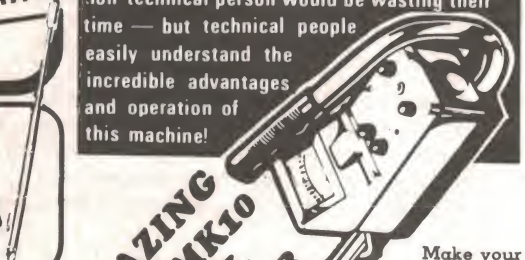

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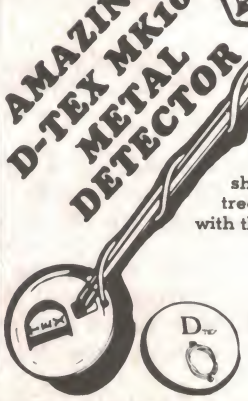

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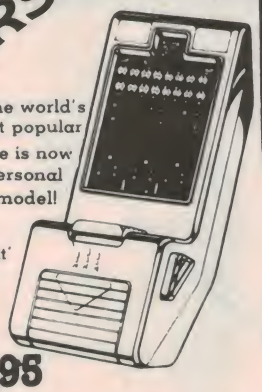

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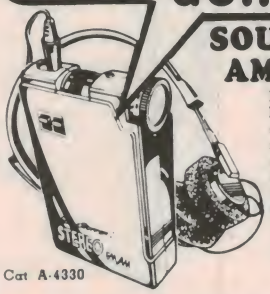

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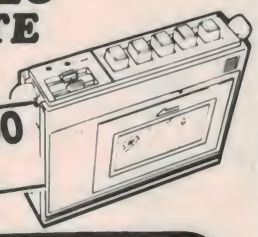

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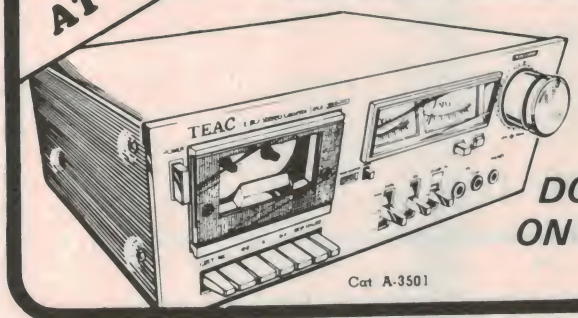

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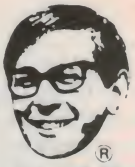


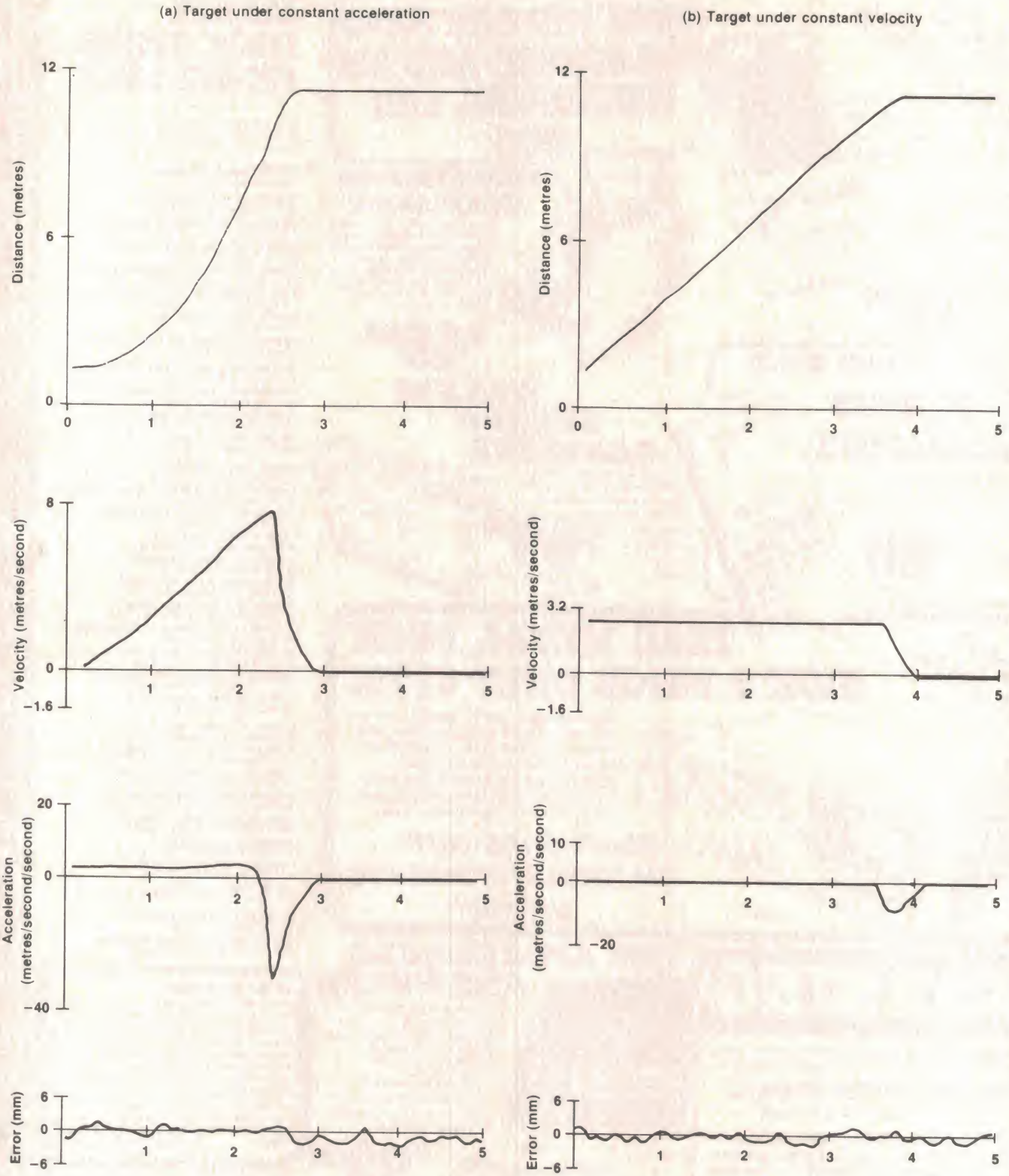


Figure 7. **Measurements of the dynamic characteristics of moving targets using the 3850A.**

The DTS may also be used to demonstrate the accuracy of the 3850A under different velocity profiles. Figure 7a demonstrates the versatility of the 3850A in determining the position, velocity, acceleration, and the resulting position error versus time of a target under constant acceleration. In spite of the nonconstant velocity profile, the position error remains quite small. Figure 7b shows a similar test run with the DTS programmed to generate a constant velocity.

Although the DTS is limited by its physical properties to a maximum

velocity of 15 metres/second, 3850A accuracy is specified for up to 40 metres/second. The physical limitations of the DTS made necessary an electronic simulation of higher-speed targets. The dynamic phase electronic tool (DPET) was developed to simulate target velocities up to 180 kilometres/second. Accuracy at these higher velocities has been verified using this device.

The speed limit

The 3850A uses three internal resolution functions to measure distance. The distance measurements roll over when the rollover interval for a particular resolution function is exceeded. The rollover intervals are 10 m for the high-resolution function and 400 m for the medium-resolution function. Thus a target at 15.241 m or 25.241 m appears to be at 5.241 m in the high-resolution function.

For a moving target the external computer must keep track of when these rollover intervals are exceeded. To accomplish this, the computer must be guaranteed that the target has not travelled more than one-half the rollover interval between successive measurements. This Nyquist speed is nominally 40 metres/second for the high-resolution function, 1600 metres/second for the medium-resolution function, and 160 kilometres/second for the low-resolution function.

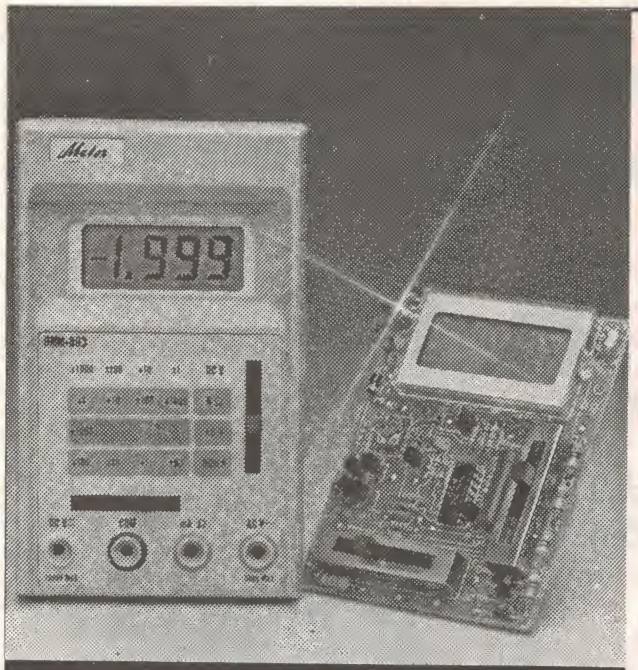
Conclusion

In conclusion, the 3850A Industrial Distance Meter has extended electronic distance measurement capability to include dynamic position measurement. With the 38001A HP-IB Distance Meter Interface, the 3850A can be computer controlled to output high-speed position and elapsed time data. Software packages now under development will enhance the system for use in automated position control, dynamic monitoring, and static monitoring.

References

1. M.L. Bullock and R.E. Warren, "Electronic Total Station Speeds Survey Operations", *Hewlett-Packard Journal*, April 1976.
2. R.R. Baldwin, G.B. Gordon, and A.F. Rudé, "Remote Laser Interferometry", *Hewlett-Packard Journal*, December 1971.

The 3850A and the 38001A were designed and developed by a Hewlett-Packard team including Jerry Bybee, Dave Rustici, Dean Buck, Rick Frey, Troy Brown, Rod Harris, Jerry Wasinger, Arnold Joslin, Randy Waite, Bill Smith and Rick Warren. ●



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		2000 V	1 V	
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OHM	± (0.5% of rdg + 1 dgt)	2 KΩ	1Ω	DC 250 V AC 250 Vrms
		20 KΩ	10Ω	
		200 KΩ	100Ω	
		2 MΩ	1 KΩ	
DC mA	± (1% of rdg + 1 dgt)	200 μA	100 nA	1 A
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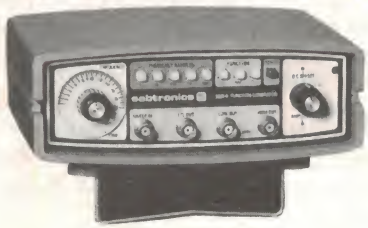

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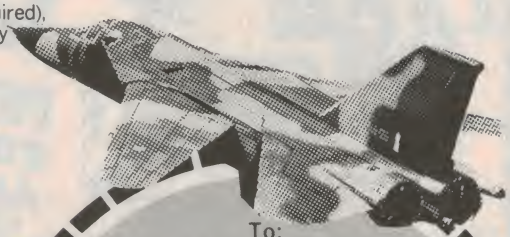

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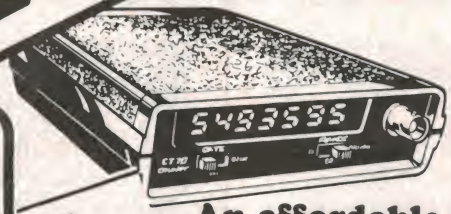

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$2.50

RED — W-4589
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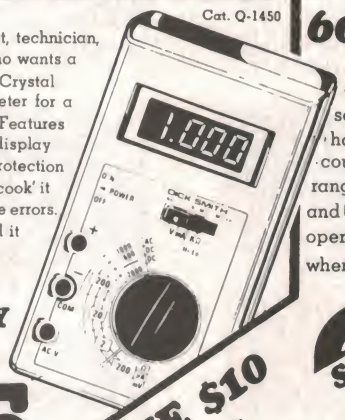
LCD DIGITAL MULTIMETER

Cat. Q-1450

For the hobbyist, technician, engineer etc who wants a reliable Liquid Crystal Display multimeter for a low low price! Features highly legible display and overload protection — so you won't 'cook' it in case you make errors. Easy to use, and it will last you for years!



NORMALLY $75

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P&P $4.00

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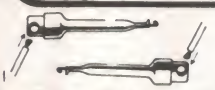
AT LAST! An affordable FREQUENCY METER

600MHz — 7 Digit

Don't be confused by the size and weight of the unit — it is NOT a toy! In fact it is a sophisticated piece of test equipment that every hobbyist can afford. Consists of a full 7 digit counter, with variable gating times and 3 ranges — 6MHz, 60MHz and 600MHz. Battery operated so it's with you wherever you go. A must!

$199

Cat. D-3000 P&P $5.50



RED — W-4580
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IC Test Clips 95¢

16 PIN IC TEST CLIP

Cat. W-4600

P&P $1.00

Eliminate the danger or shorting out pins with this spring loaded Test Clip!

$3.50

IC Jumper Lead Set

A pair of red and black leads, one metre long with matching IC test clip at each end.

$3.80

Cat. W-4572

SUPERB VALUE! 100MHz PROBE SET

Normally used for CROs, but ideal for above counter on a x 1 scale. At a bargain price compared to other probes.

$34.50

Cat. Q-1245 P&P $3.00

MINI ALLIGATOR CLIPS

Fully insulated with plastic shroud, easy to solder to. Two colours available. 80¢ each.

RED — W-4550
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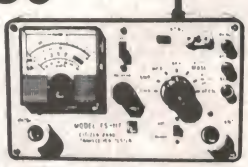
Still only $49.50

VALUE!

27MHz TX/RX TESTER



Cat. Q-1380 P&P $3.00

This set has been specially developed for the servicemen to facilitate the location of faults in hand held transceivers etc. Now everyone can afford this luxury! This compact portable unit is a must for every amateur enthusiast. Call in and check out the tremendous features it has to offer!

PRO QUALITY FOR THE KEEN AMATEUR!

SWR/Power meter

Cat. Q-1340
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OSKER BLOC

This is a truly professional instrument that uses the Through-Line principle. Covers 3MHz to 200MHz. Each unit is individually calibrated with a chart attached to the instrument.

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RESISTANCE SUBSTITUTION WHEEL

Changes values of resistance in circuits.

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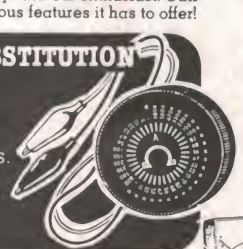

LOGIC PROBE

A superb time-saving tool for the hobbyist, technician etc. Hooks onto the circuit under test for its power. Many other features.

$27.50

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BUDGET METERS

Cat. Q-1020

20 kohm Multitester

This may be low budget — but this one gives a top performance for the price! An amazing 20,000 ohms per volt and it's under $20.00!!

$19.50

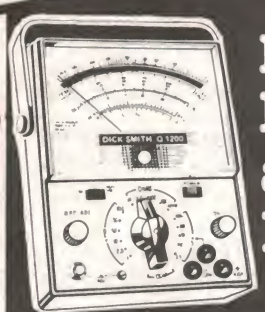
P&P $2.00

A pocket multimeter for the beginner or the handyman. If you're just starting out in the world of electronics and you have a tight budget — look no further. Simple operation.

Cat. Q-1010 P&P $2.00

Pocket Multi-Tester

$12.50



High Impedance Meter

Cat. Q-1200

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P&P $4.00

For the professional who wants the lowest circuit loading. . . . incredible 10M imp. (DC) even has centre zero range!

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ON THIS TOP VALUE CRO

6.5MHZ

75mm

We still can't believe the incredible response we're having on this affordable CRO. We have literally sold thousands of them in the past 12 months — the sales speak for themselves. Suitable for any application — laboratory, classroom, field work, and of course the hobbyist.

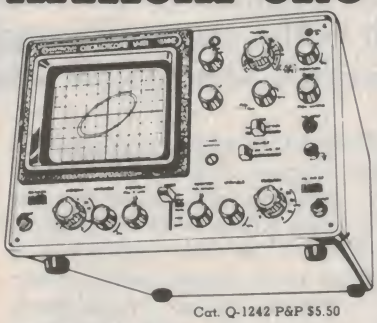
SAVE $10!

Normally $199

$189 THIS MONTH ONLY

Cat. Q-1280
P&P $5.50

LOOK AT DICK'S PRICE FOR A TOP NAME HITACHI CRO



Cat. Q-1242 P&P $5.50

15MHz Dual Trace

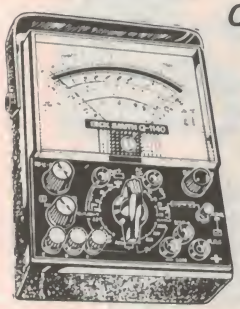
If you're after the very best, then look no further! We're offering this fantastic Hitachi V-152B Dual Trace CRO at a very affordable price.

Check these features:

- Extra high sensitivity
- 5 display modes
- Trace rotation via front panel control
- Colour-codeed panel layout for operating ease
- TV sync-separator circuit for rapid video measurement
- One touch wave-form shifting

ONLY **$638**

TWO TOP METERS FROM DICK SMITH

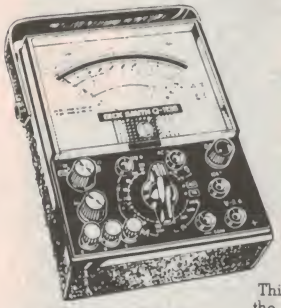


Q-1140 PRO QUALITY METER

This handy little unit is virtually a test bench in one small package! Not just a sensitive (100k/V) multimeter. This one checks transistors and measures capacitance etc. Fuse and diode protection of the movement. If you want a multimeter that will do just about anything. — look no further! Complete with battery, test leads, and full instructions.

$72.50

Cat. Q-1140 P&P $4.00



Q-1136 transistor checker multi-meter

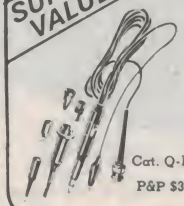
Cat. Q-1136
P&P $4.00

$57.50

This unit is similar to the one above except for a few minor differences. i.e. does not have capacitance checking facilities, nor does it have a 250mV DC position. But the really good news is that it's CHEAPER!! Everything else is much the same,so it is up to you — the money or the best!

UNBELIEVABLE VALUE!!!

SUPERB VALUE! 100MHz CRO PROBE



This incredibly versatile probe set is so good we thought we'd mention it twice Ideal for any CRO and comes with an abundance of accessories!

Cat. Q-1245
P&P $3.00

$34.50

CRO Adaptor

Plugs into the Dick Smith CRO enabling accessories from more expensive sets to be used.

$9.50 Cat. Q-1281

HANDY METER CARRY CASE

This offers more than just protection for your valuable meter. Also keeps your leads and instructions tidy and gives you room to store notes etc. Suits models Q-1136, Q-1140 & Q-1024.

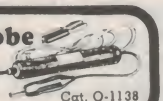
$14.50

Cat. Q-1137 P&P $2.00

Multimeter RF Probe

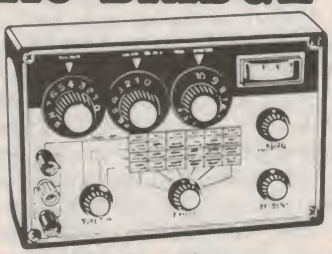
Extend the useful range of your multimeter with this neat probe
150kHz — 30MHz

$17.50 P&P $2.00



Cat. Q-1138

HIGH ACCURACY AC BRIDGE



Better than a multimeter. . . with this Bridge you can accurately and easily measure inductance, capacitance, resistance, compare unknown components etc. Easy to use and very affordable!

$79.50

Cat. Q-1420 P&P $4.00

DICK SMITH Electronics

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®

Versatile electronic stethoscope

Design: Ray Marston
Development: Simon Campbell

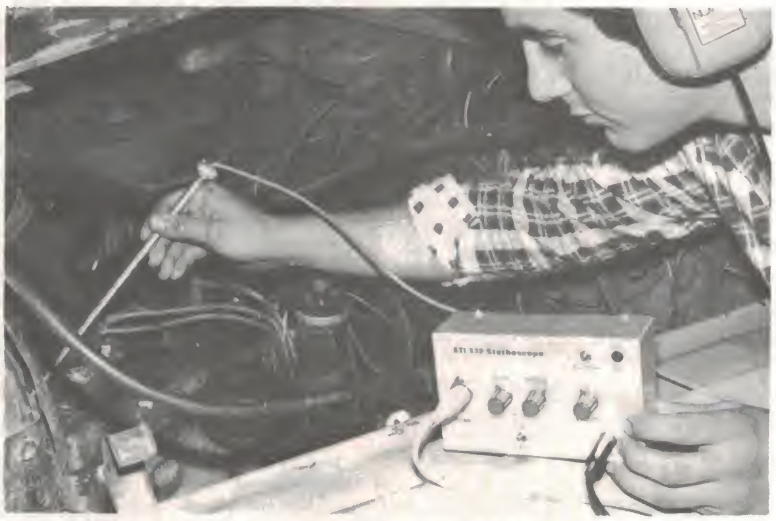
This unusual device can be a very handy tool for those who work with mechanical contrivances — anything from tractor engines to drill presses to watch mechanisms. Thrill to the clatter of clagged-out tappets, the grind of graunched bearings, the tick-tock of escapements . . .

"DOCTORS DO IT with stethoscopes ..." said the bumper sticker on the expensive imported car parked in the street near our offices. With this project, you can do it too! The purpose of a stethoscope is to enable you to hear what's happening inside an operating mechanism when it's difficult or impossible to see what's happening — in fact, listening may be better than seeing in some instances.

With this electronic stethoscope, you can effectively and effortlessly get right inside a car engine, for example, and listen to or locate all its internally generated sounds — the noise of bearings, pistons, tappets, etc. The various sounds produced by different parts of moving machinery have different characteristics, so this stethoscope incorporates a double filter network that can be used to pick out one set of sounds and attenuate others, thus facilitating fault-finding.

The stethoscope comprises an acoustic probe unit using some sort of microphone (several combinations are possible), the electronic 'clever bits' and a pair of standard stereo headphones. The probe unit is arranged to make mechanical contact with the machinery or object being examined and is coupled to the electronics, which are housed in a separate box, via flexible leads. The mechanical coupling provides an acoustic path to the microphone in the probe, and can be by direct contact or via a metal rod or tube.

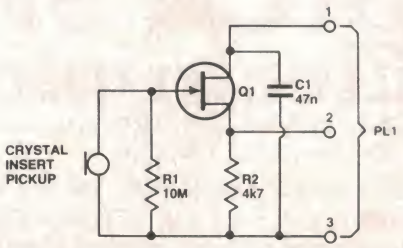
Sound is readily transmitted through the housing of any machinery, be it the engine block of a petrol motor, the case of a watch or clock, etc. This can be further transmitted through an object, such as a metal rod or a screwdriver, brought in contact with the machinery.

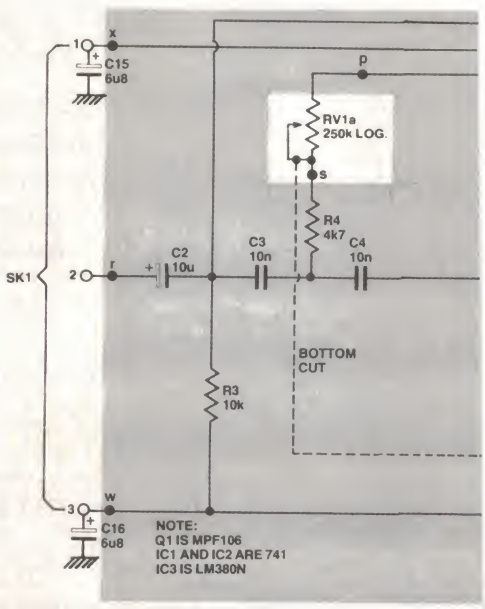


Using the stethoscope to listen to the tappets in a car engine.

The electronics

The circuitry used in this stethoscope comprises two filters, each of which has a variable cutoff, followed by a high gain IC power amplifier. The first filter is a *high-pass* type that attenuates frequencies *below* the cutoff frequency, which can be set anywhere between about 80 Hz and 3 kHz. The second filter is a *low-pass* type that attenuates frequencies *above* the cutoff frequency, which can be set anywhere between about 70 Hz and 15 kHz. The filters can thus be used to attenuate unwanted sounds, enabling you to pick out the desired sounds to a considerable extent in the right circumstances. The filter stages can be switched out if desired and the probe's microphone output coupled directly to the audio output stage. A common LM380 has been employed for the latter, principally for convenience, as it provides a considerable amount of gain and requires few components. A volume control potentiometer has been placed at the input to the LM380, since a level control is a very necessary item — as no doubt you will discover!





The unit is powered from two internal 9 V batteries as portability is a necessary requirement. Headphones were employed rather than having a loudspeaker output, as they reduce ambient sounds which in some situations make listening to a speaker impossible as well as enabling you to concentrate on the sounds picked up by the stethoscope. Only low-cost headphones are necessary and any type having an impedance between 8 ohms and 500 ohms or so will do the job nicely.

The input impedance of the electronics is relatively low and a buffer is necessary when using high impedance microphones on the probe. The low input impedance also serves to reduce extraneous electrical noise pickup, to which high input impedance circuitry is prone. Crystal microphone inserts or earpieces are cheap, sensitive and effective for probe use, although we did try a rocking armature insert successfully, coupled directly to the high pass filter input. The buffer necessary with crystal microphones we mounted on the rear of the mics, as you can see from the photographs and drawings.

The stethoscope electronics are housed in a *metal* box — and for a very good reason. It provides shielding for the circuitry, preventing extraneous electrical noise pickup — which can be quite severe when using the project on a car engine. The ignition wiring radiates a considerable amount of noise energy and, while it's not possible to completely eliminate it, we have reduced the problem by using a metal box, low impedance input and bypassing at the input socket.

Construction

It's probably best to commence with the mechanical work. We housed our unit in a K&W box, model C642, made by Ballarat Electronics Supplies and stocked by many retailers. It measures 150 mm wide by 95 mm deep by 55 mm high. Any metal box that will accommodate the pc board and major components may be used, however. Our Scotchcal front panel has been de-

HOW IT WORKS — ETI 332

Mechanical noises are coupled to a microphone or mic insert by a convenient means in a probe, the mic converting the mechanical noise to electrical signals. The resultant signal is passed to a filter/amplifier unit and converted to sound by headphones. Two active filters are employed. The first is a high-pass type employing a second-order RC network. This circuit has the advantage that the response rolls off below the cutoff frequency at a rate of 40 dB per decade. Thus, signals at one-tenth the cutoff frequency are attenuated by 40 dB. The R and C values may be designed to provide the cutoff at the desired frequency. The filter response is 3 dB down at the cutoff frequency. In our circuit, the resistors have been replaced by a combination of fixed and variable resistors to provide a variable cutoff frequency. The high-pass filter consists of IC1 and RV1, C3, C4, R4, R5. The filter has been designed to provide a cutoff that can be varied between a minimum frequency of 80 Hz up to a maximum of 3 kHz. Thus, with RV1 set to provide a cutoff of 1 kHz, signals at 100 Hz will be attenuated by about 40 dB.

The second filter, following the high-pass filter, is a low-pass type, again using a second-order RC network to provide a roll-off of 40 dB per decade, above the cutoff frequency. Again, the filter response is 3 dB down at the cutoff frequency. In our circuit, the resistors have been replaced with a combination of fixed and variable resistors to provide a cutoff frequency which can be varied at will. The low-pass filter consists of IC2 and RV2, C6, C7, R6, R7. The cutoff may be varied between about 700 Hz minimum and 15 kHz maximum. When RV2 is set to provide a cutoff at about 1 kHz, for example, signals at 10 kHz will be attenuated by about 40 dB.

The filter stages provide no gain. The op-amps employed require a spiit supply and the 'virtuai zero volt rail' is provided by ZD1, which is biased via the buffer amplifier involving Q1. Capacitor C8 provides an ac bypass for the virtual zero volt rail.

The output from IC2 is coupled to the audio output stage via SW1, which permits the filter stages to be switched out of circuit.

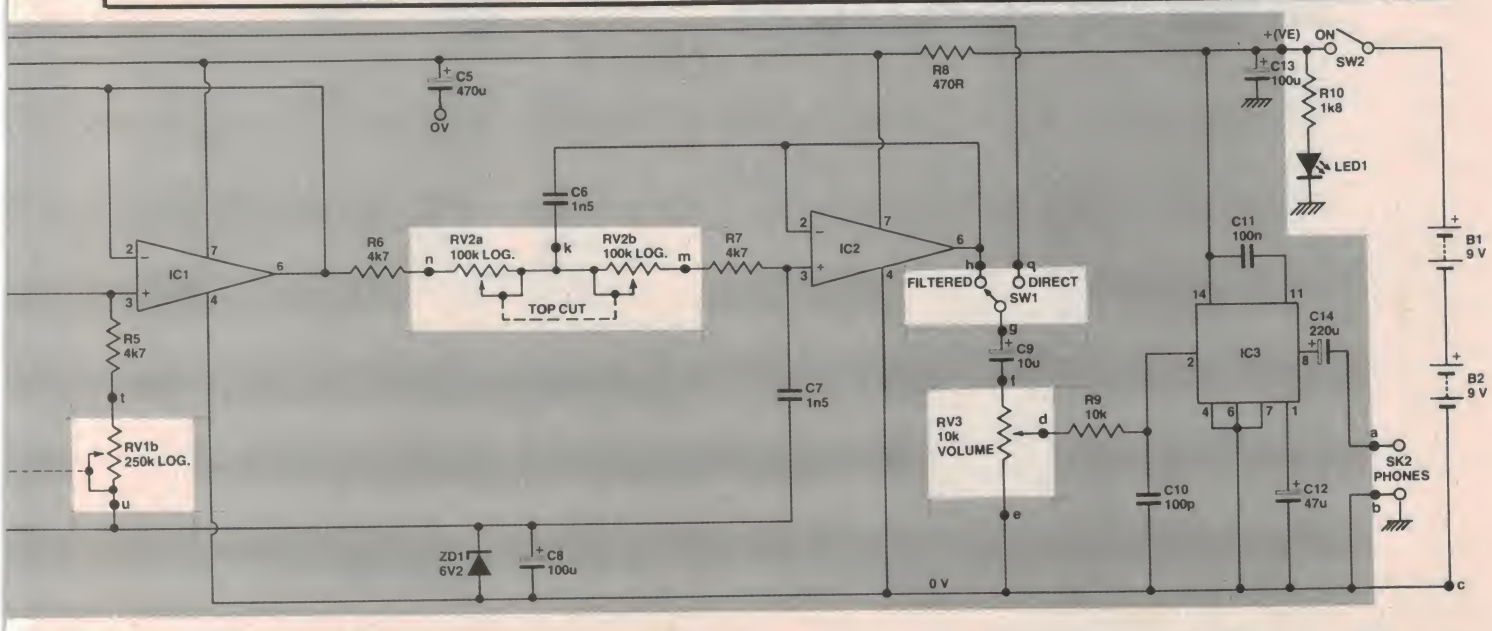
As stated earlier, high impedance crystal type mics require a high-to-low impedance buffer. This is the function of Q1 and associated components, R1, R2, C1. This is a simpie source follower circuit, Q1 being a JFET device. Capacitor C1 provides a suppiy rail bypass.

Signals are passed either direct to the output stage or through the filters via SW1. Capacitor C9 provides dc biocking and couples signals to the voiume controi, RV3. The audio output stage employs an LM380 high gain preamp/power amp IC. Signals from the volume control are coupled to the input via R9/C10, which is a low-pass network with a cutoff around 150 kHz. This provides a measure of high frequency stability for the iC as well as reducing RF pickup that can upset the operation of the unit. Audio output is coupled via C14 to the headphones. Capacitors C11 and C12 are bypasses.

Power supply for the electronics is provided by two 9 V batteries connected in series. Suppiy rail bypassing is provided by C13 and R8/C5. LED1 and its associated current limiting resistor, R10, provide an 'on' indicator.

Capacitors C15 and C16 bypass any extraneous electrical noise induced onto the input cable. These are mounted directly at the input socket.

If a rocking armature insert is used for the probe, a 4k7 resistor should be connected between pins 1 and 3 of the input DIN plug to provide bias for the virtual zero volt line provided by ZD1.



Completed stethoscope, ready for action! The probe here was made from a crystal earpiece, a length of 10 mm tubing being pushed over the ear plug.

signed to suit the K&W box. The artwork for this has been reproduced below, full size, and can be used as a template to mark out hole centres for drilling. The pots, switches, etc, all mount on the box lid. Use a centre-punch to locate hole centres before drilling as this stops the drill wandering. Once you've completed this, clean off any burrs with a small rat-tail file and see that the pots, switches, etc, fit properly. If all's well, carefully cut the Scotchcal panel to size (if you're using it) and apply it to the box lid. Then cut the holes on the Scotchcal panel where you drilled the lid.

Next, mount all the pots, switches and sockets, etc. Solder the input bypassing capacitors, C15 and C16, to the DIN socket as shown in the wiring diagram. Note that the value of these two capacitors is not critical and may be anything between 1u and 10u. Solder R10 in place.

You can tackle the pc board next. This is fairly straightforward. We recommend you use our pc board, as the LM380 is prone to instability unless its surrounding circuitry is mounted in a particular fashion. Our pc board will avoid any instability problems with this stage. The ICs may be mounted first, noting they are all oriented the one way, followed by the resistors, greencaps, the ceramic capacitor (C11) and the zener diode (watch its polarity), leaving the electrolytics until last. All the electrolytics are single-ended, pc mounting types, you'll notice. Take care you mount these the right way round.

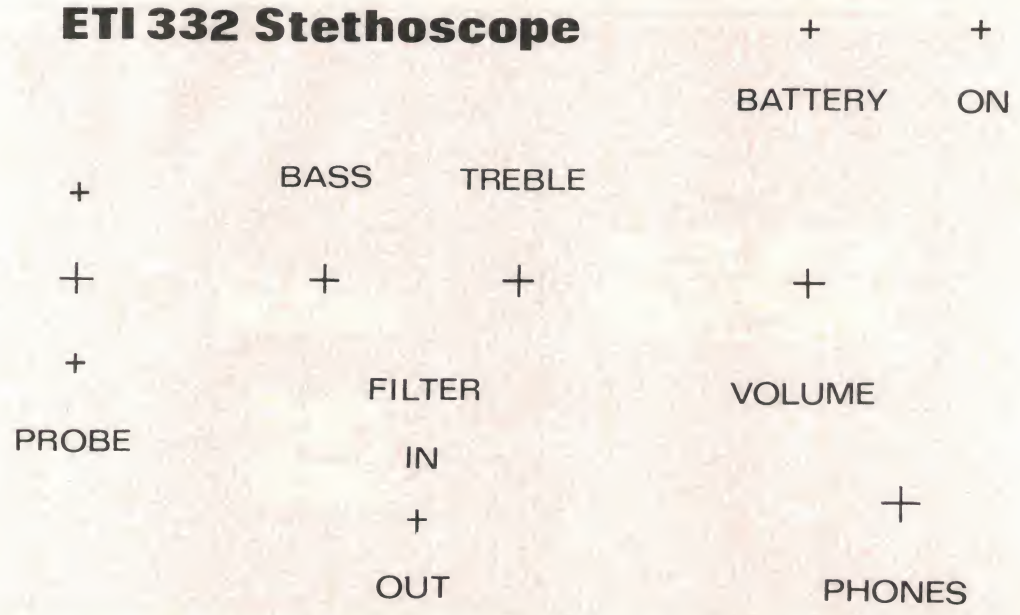
Having completed the loading of the board, check everything *carefully*.

The wiring between the pc board and external components may be tackled next. Follow the wiring diagrams for this stage of the construction, checking each set of wires as you proceed.

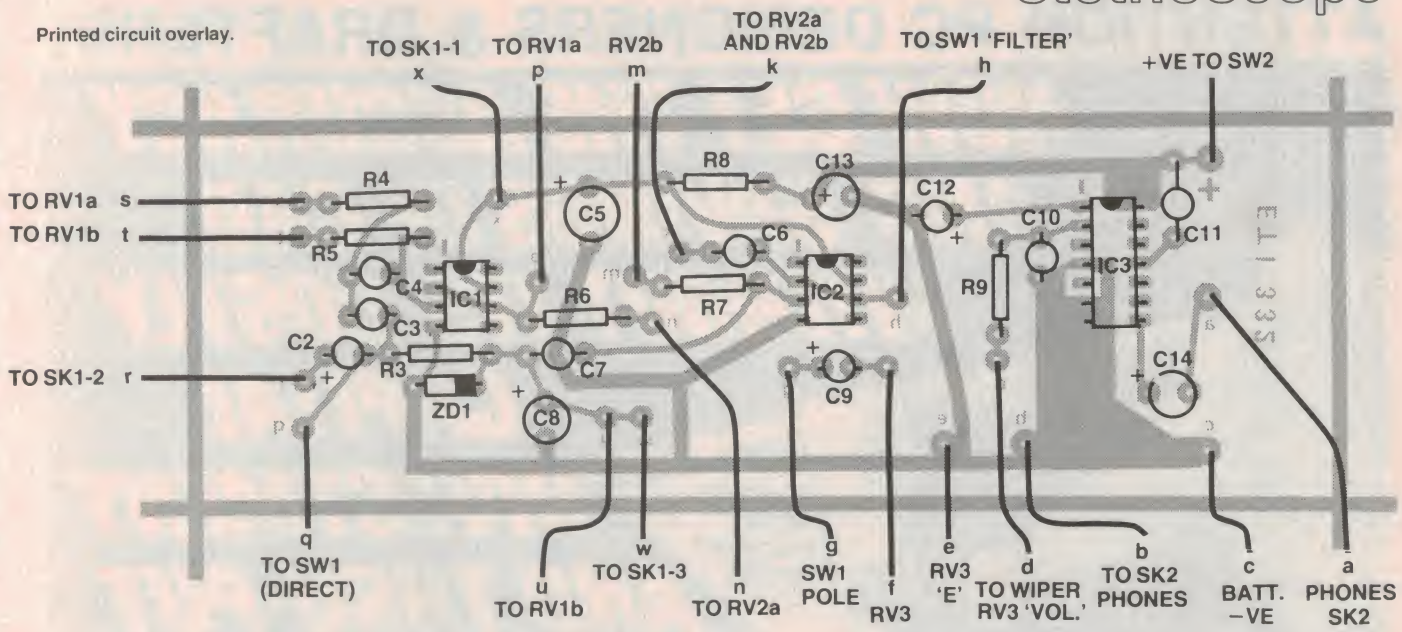
You can make a preliminary check of the electronics once you've completed this stage. Check your wiring first, then connect the two batteries, turn the volume control to minimum, plug in your headphones and switch on. Some hiss should be evident; this is normal. With the filter switched in, turning the volume control fully up (do it slowly) should result in a slight increase in the noise level. Turn the volume control to minimum gain and switch the filter out. Touch your finger to pin 2 of the DIN socket and slowly advance the volume control. This should produce some audible noise and hum. The hum level will depend on the local hum field. If it is low, you may have to advance the volume control a fair way.

If all checks out well you can mount the pc board in the bottom part of the case, along with the batteries. We used double-sided sticky pads, as they're effective, convenient and save drilling!

Making the probe(s) comes next. Exactly how you go about this will depend on what you want to do. With crystal insert mics, the buffer is mounted on the rear of the mic terminals. The accompanying probe wiring diagram shows the general



Printed circuit overlay.



technique. The buffer electronics is protected by encapsulating it in quick-setting epoxy. The mechanical coupling arrangement will depend very much on the particular mic insert employed and the application you have in mind. We made up several probes to suit different applications. If the mic has a metal case connect it to the probe cable's shield.

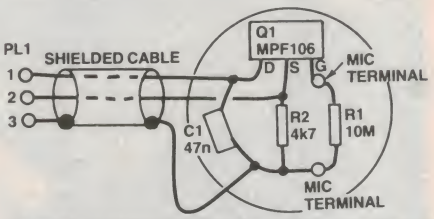
When you've finished your probe you can test it by simply coupling it to the speaker of a small portable transistor radio. Check that the filter controls function by varying them across the full range.

Using it

The best way to get to know how to use the instrument is to practise on a few things. Clocks are wonderful for this! The old-style mechanical wristwatch also provides an excellent signal source. You can hear your heartbeat by using a microphone insert without a mechanical probe, and we even discovered that the main bearing in our workshop drill press was 'cactus' when trying out the stethoscope!

When working on a vehicle engine, watch out for fan blades. We found we could effectively sort out various engine sounds by judicious adjustment of the filter controls and careful placement of the probe.

Happy listening! ●



General construction for the buffer, mounted on the rear of a mic insert.

PARTS LIST — ETI 332

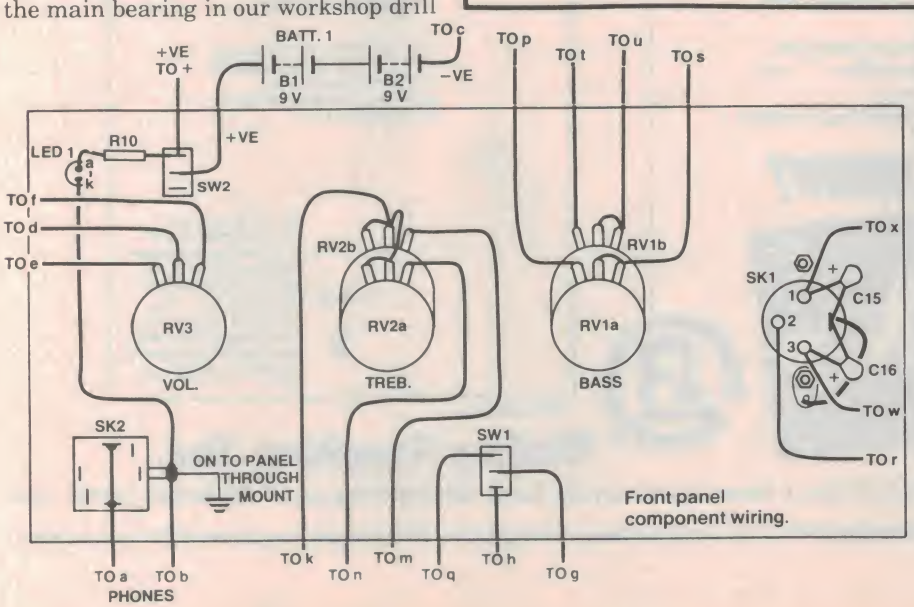
Resistors all ½W, 5%
- R1 ..... 10M
- R2, 4, 5, 6, 7 ..... 4k7
- R3, R9 ..... 10k
- R8 ..... 470R
- R10 ..... 1k8
- RV1 ..... 250k/C dual log.
- RV2 ..... 100k/C dual log.
- RV3 ..... 10k/C log.

Capacitors (all electros single-ended)
- C1 ..... 47n polycarbonate
- C2, C9 ..... 10u/25 V electro.
- C3, C4 ..... 10n greencap
- C5 ..... 470u/25 V electro.
- C6, C7 ..... 1n5 greencap
- C8, C13 ..... 100u/25 V electro.
- C10 ..... 100p ceramic
- C11 ..... 100n greencap
- C12 ..... 47u/25 V electro
- C14 ..... 220u/25 V electro.
- C15, C16 ..... 6u8/25 V tantalum.

Semiconductors
- IC1, IC2 741
- IC3 ..... LM380
- Q1 ..... MPF106 or similar
- LED1 ..... TIL220R red LED, or sim.

Miscellaneous
- SW1 ..... SPDT toggle switch
- SW2 ..... SPST toggle switch
- PL1 ..... 3-pin DIN plug
- SK1 ..... 3-pin DIN socket
- SK2 ..... 6.5 mm stereo headphone socket (or to suit plug-on headphones)
- B1, B2 ..... No. 216 9 V batteries and clips to suit

ETI-332 pc board; case — 150 x 95 x 55 mm or similar (we used a K&W model C642); three small collet knobs or similar; Scotchcal front panel; one crystal earpiece or crystal mic insert; rod or tube for probes; two-core shielded cable; one pair of 8 ohm headphones (higher impedance types will also be OK); wire, nuts, bolts, etc.



Front panel component wiring.

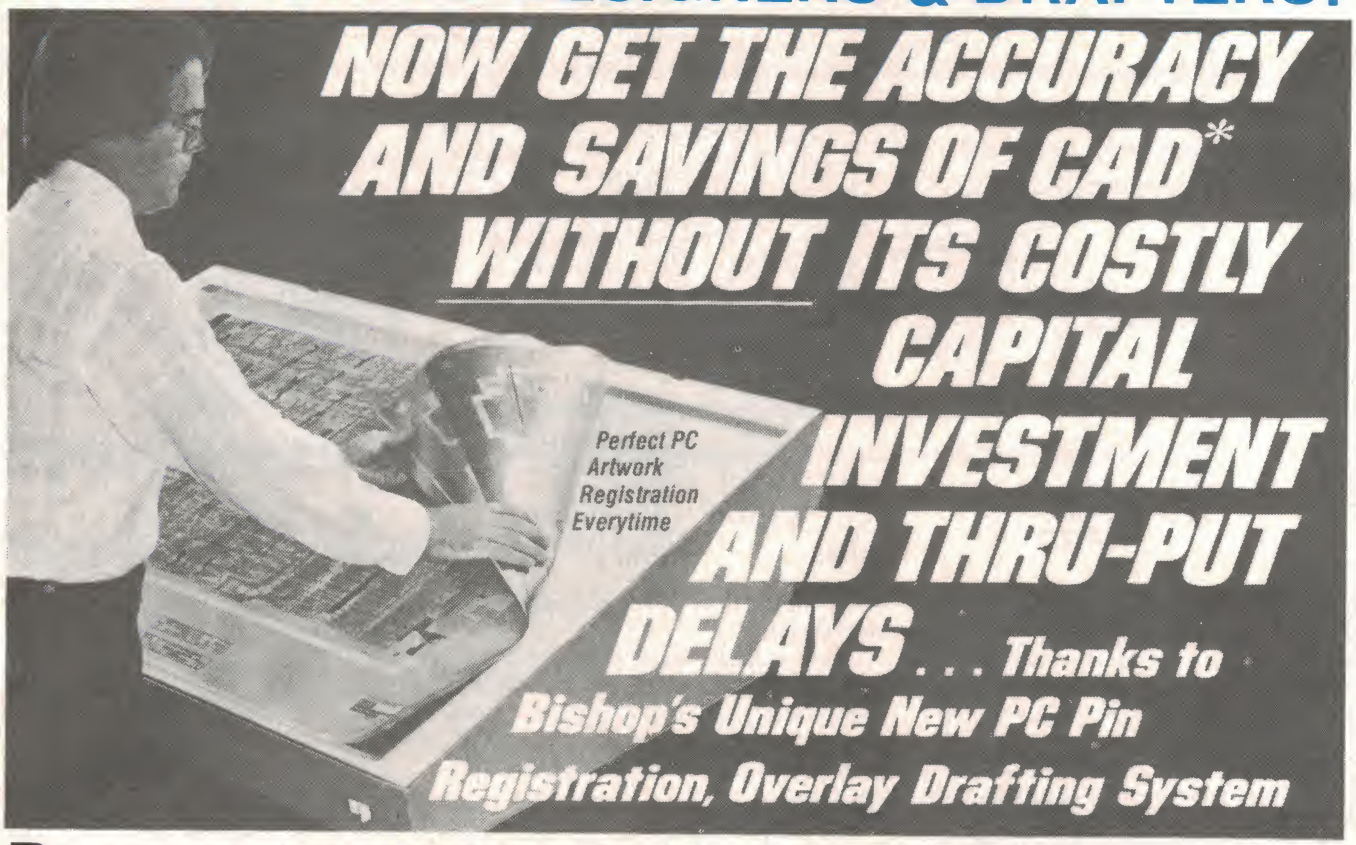
Price estimate

We estimate the cost of purchasing all the components for this project will be in the range:

$35 - $40

Note that this is an **estimate** only and **not** a recommended price. A variety of factors may affect the price of a project, such as — quality of components purchased, type of pc board (fibreglass or phenolic base), type of front panel supplied (if used), etc — whether bought as separate components or made up as a kit.

ATTENTION PC DESIGNERS & DRAFTERS!



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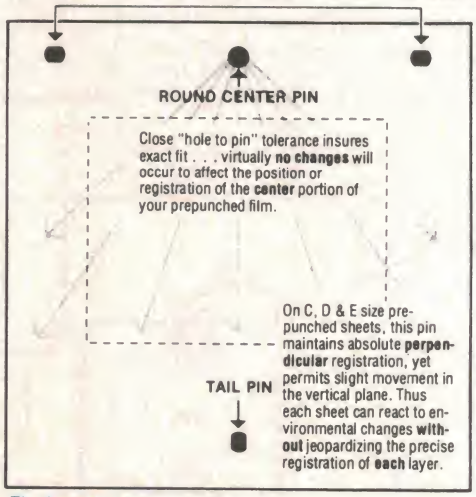

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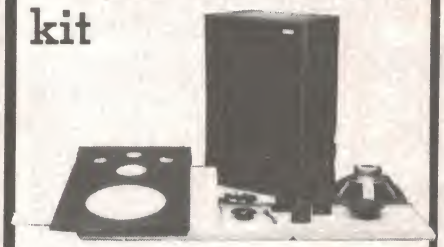

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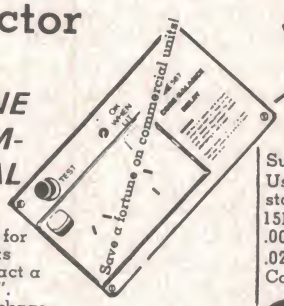

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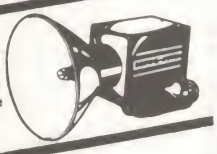

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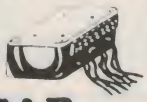

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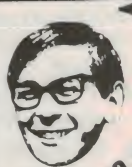

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REMEMBER: They look so good your friends will never believe you built them!

An 'intelligent' battery charger

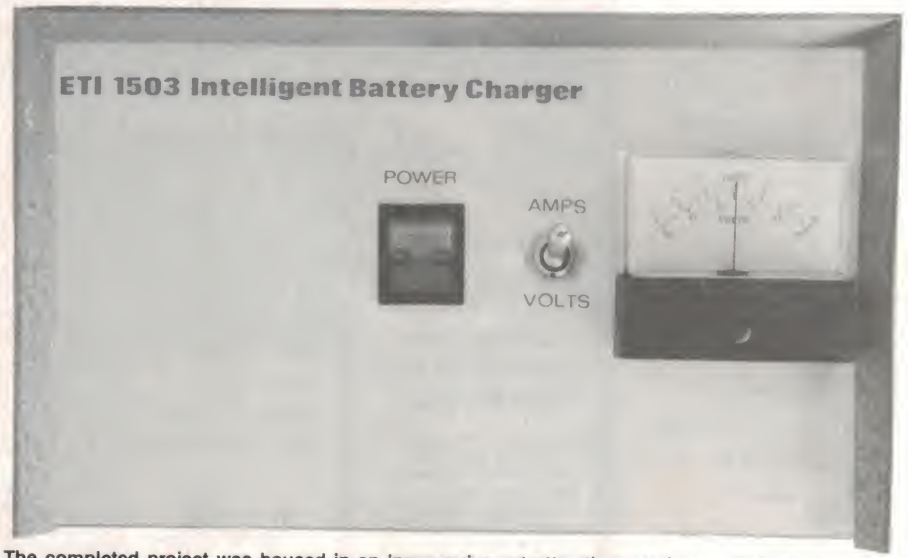
This is no ordinary battery charger. If you run a house alarm system, an amateur repeater or any electronic system with a 12 V battery 'back up' supply, this charger will keep that battery in a healthy state. It has other uses, too.

Jonathan Scott

IT IS PERHAPS too little known a fact that lead-acid batteries are not happy if left fully charged or discharged. They need to be used to stay in good condition. This is not, as a rule, a difficult situation when the battery is in a car, say, because it is called upon to run clocks or parking lights and to start the engine, and is charged when the engine is running. Some cars even arrange for the battery to be discharged to some extent when the engine is running and the lights are on (a mechanism into which we will not go just now). However, sad is the battery used as a burglar alarm power back-up system where it is continuously topped up, awaiting the moment when the mains fails. The battery fails too often before the mains supply!

As well as avoiding that situation, this charger maintains the 'spare' battery you keep in the garage for when that blighter of a P-plate driver son of yours borrows the Kingswood and leaves the lights on in the garage. Perhaps you charge it periodically at present, but the poor battery does not do any of the work that is necessary for its health and well-being.

Many amateur radio repeaters, popular on the VHF and UHF amateur bands for mobile operation with low power transceivers, employ (or should!) a battery back-up system. When a mains failure occurs the battery may be called upon to supply a pretty arduous load, cycling from a relatively low current in the listening mode to much higher currents when transmitting. To provide an operating time anywhere near the battery's rated capacity, the battery must be in 'good' condition. 'Float' or trickle charging will not ensure that.



The completed project was housed in an inexpensive yet attractive metal case, dressed up with a Scotchcal front panel label. A Scotchcal label could be used for the meter scale; however, University Graham Instruments will be supplying ready-made scales for these meters.

It is to overcome this sort of problem that we have designed this 'intelligent' battery charger.

This device monitors the state of charge and waits dormant until the battery is beginning to get flat. When it is low, but not in the deep discharge region, it turns itself on and charges the battery until it is full, whereupon it goes to sleep again until the battery is near exhausted, and so on. This has the disadvantage that there is an element of luck as to how charged the battery will be at any moment, but it is quite likely to be enough to start a car, for example, or to ring an alarm bell for quite a period. And it will be *just the same* in three months time.

In the burglar alarm back-up application this unit is ideal. It can also be used in conjunction with a load, such as the ETI-147 (Oct. 1980), to 'recycle' a battery to restore lost capacity, or perform tests on a battery in a simulated load situation (how long will it run parking lights?). These last two are the original applications for which it was designed.

Although we have not specifically included it in the circuit, it is a good idea to have a small load on the battery when it is connected to the charger. We have provided terminals on the unit from which to draw power, as we expect the unit will be powering an alarm system or similar. If it is used to keep a spare battery healthy we recommend that a load such as a 180 R, 1 W resistor or a one-watt light globe be connected across the terminals to give a constant but small current drain.

Before we get into the construction,

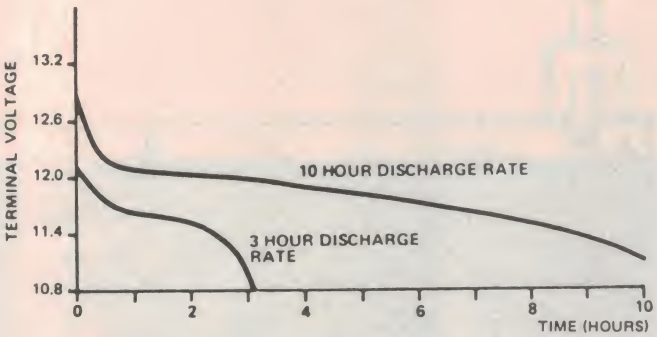


Figure 1. **Typical discharge characteristics of a 12 V (nominal) lead-acid battery.**

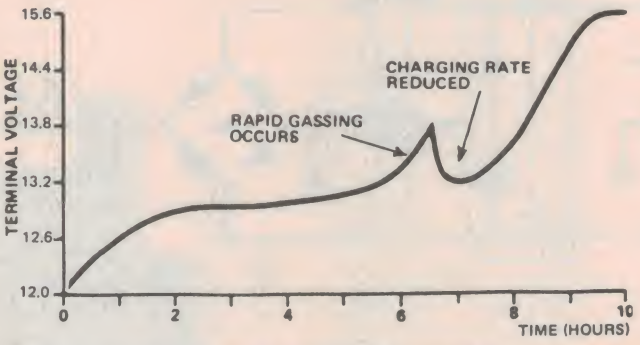


Figure 2. **Charging characteristics of a 12 V (nominal) lead-acid battery. The 'kink' in the curve near six hours is explained in the text.**

let's take a look at the characteristics of lead-acid batteries to gain an understanding of what happens when you discharge and charge them.

Lead-acid batteries

The fully-charged, no-load terminal voltage of a lead-acid cell is between 2.3-2.4 volts. This drops under load to about 2.0-2.2 volts. When discharged, the cell voltage is typically 1.85 volts. The amp-hour capacity is determined from a 10-hour discharge rate. The current required to discharge the battery to its end-point voltage of 1.85 V/cell is multiplied by this time; e.g: a 40 AH battery will provide four amps for 10 hours before requiring recharge. Note however that the amp-hour capacity varies with the discharge current. The same battery discharged at a rate of 10 amps will not last four hours; on the other hand if it is discharged at 1 amp it will last somewhat longer than 40 hours. The typical discharge characteristics of a (nominal) 12 V battery are shown in Figure 1.

The ideal initial charging current for the fully discharged battery (cell voltage under 2.0 V) should be about 20 amps per 100 amp-hours of capacity (i.e: 8 amps for a 40 AH battery). Once the electrolyte begins to gas rapidly, the terminal voltage will be around 13.8 volts and rising rapidly. At this point, the charging current should be reduced to somewhere between 4-8 amps per 100 AH until charging is complete.

At the end of charging, terminal voltage may rise to about 15.6 volts or more, but this decreases slowly after the charger is removed, the terminal voltage then usually reading around 14.0 to 14.4 volts (see Figure 2).

This project may be used with batteries having rated capacities from 4 AH to 100 AH, providing it is set up for the battery in use, according to the set-up procedure given at the end of the article.

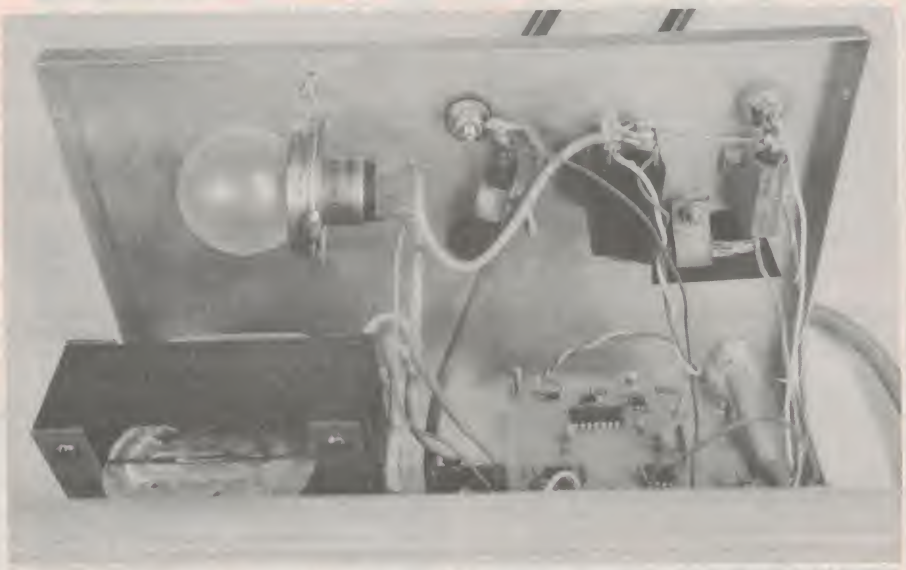
Construction

The component layout is not critical with this project, so there is no need to adhere strictly to the details which follow, provided you know roughly what you are about. The only constraint is that quite a lot of power (60-odd watts) is dissipated by the circuit as a whole and so the design needs to be fairly open and well ventilated.

We used a 'K&W' model C1066 box which allows plenty of room and has good ventilation slots in the sides and top. The first step in the construction is to set the major components out inside the box where you will want them and check that there is enough 'room to move' and that wiring will be easy. Mark the positions for mounting holes with a soft lead pencil, then remove the bits and pieces and drill the holes. We used a 6 V headlight globe from Volkswagen for LP1, which we mounted by soldering some 18-gauge tinned copper wire to the metallic collar and forming bolt holes in the ends of the wire. This held it most satisfactorily about 10 mm from the rear panel of the case, just below a set of vent slots.

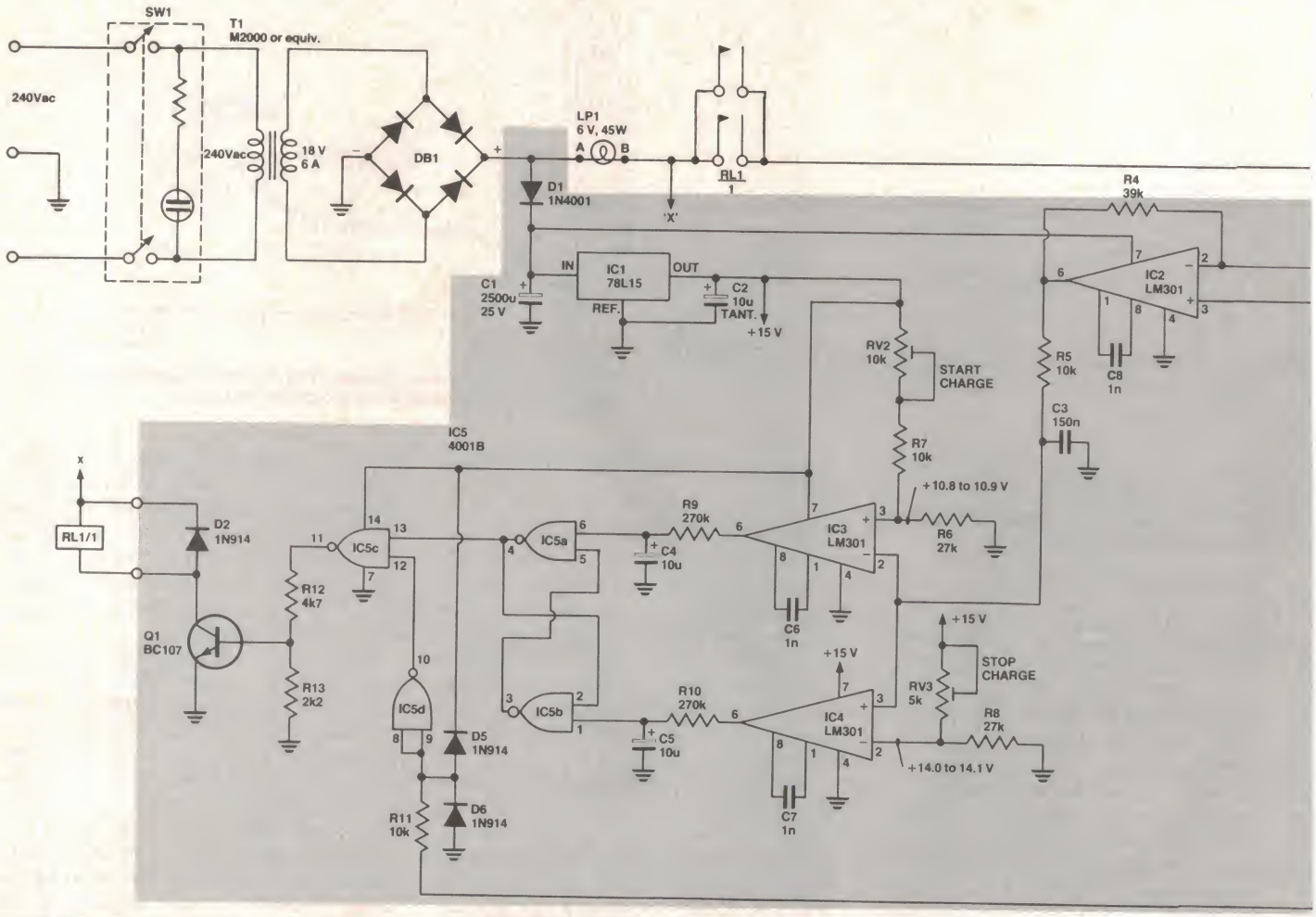
Next fit the components to the pc board as shown in the overlay, starting with the resistors and capacitors and finishing with the ICs. Take care to observe the correct polarity with the electrolytic capacitors, diodes and ICs. Attach adequate lengths of hookup wire, where applicable, to the pc board.

Next, fit and interconnect the various components in the box. The metal-clad power resistor, R1, will be carrying up to 15 A or so at maximum and thus should be connected to the battery and the output terminals by short lengths of the heaviest cable possible. We used 6 mm-thick automotive starter-type ▶



View of the rear panel showing how we mounted the various major components. Note the 45 W lamp 'ballast'. The relay was glued in place between the two output terminals. The Arcol metal-clad resistor is mounted as close as possible to the positive output terminal.

Project 1503



HOW IT WORKS — ETI-1503

The overall function of the device is as follows: when the open-circuit potential of the battery falls to below about 10.8 volts the charger turns on, charging the battery until the potential rises to about 14 volts, whereupon it turns off the charging current and waits dormant until the cycle repeats.

Let us start by considering the conditions when a normal, partially charged battery is connected and the unit is dormant. IC2 in conjunction with R1 and the surrounding components are connected to determine the open-circuit voltage potential of the battery even though it may have a load drawing power. IC1's output is equal to the terminal voltage of the battery minus about 4 times the voltage across R1, times the reduction fraction of RV1; mathematically it is:

$$V_{out} = V_{battery\ terminal} - \frac{39k}{10k} \times V_{across\ R1} \times K$$

where K is the fraction between 0 and 1 determined by RV1

When a load current is drawn from the battery a voltage = $I_{load} \times R1$ is dropped across R1. With respect to the voltage at the junction of R1 and the battery (the reference for IC2) this potential is negative. By choosing K to be the correct value, which is:

$$K = \text{Internal Resistance of battery} \times \frac{1}{3.9} \times \frac{1}{R1}$$

$$V_{out} = V_{battery\ terminal} + I_{load} \times IR_{battery} = V_{open\ circuit}$$

Since K cannot, of course, exceed a value of one, the circuit will handle batteries with internal resistances up to 3.9 times R1, or about 85 milliohms. This should be adequate for all car batteries, but doubling R4 to, say, 82k, will enable batteries with up to 180 milliohms internal resistance to be used, and so on.

Having ascertained the function of IC2, let us now consider the action of the rest of the circuit. IC3 and IC4 act as comparators. The output of IC3 goes high when the battery open-circuit voltage falls to below 10.8 volts. This level is set by RV2, which compensates for offsets and component tolerances. The output of IC4 goes high when the open-circuit battery voltage rises to above 14 volts. This is set by RV3. These levels correspond to a battery at the ends of its healthy charge/discharge curve.

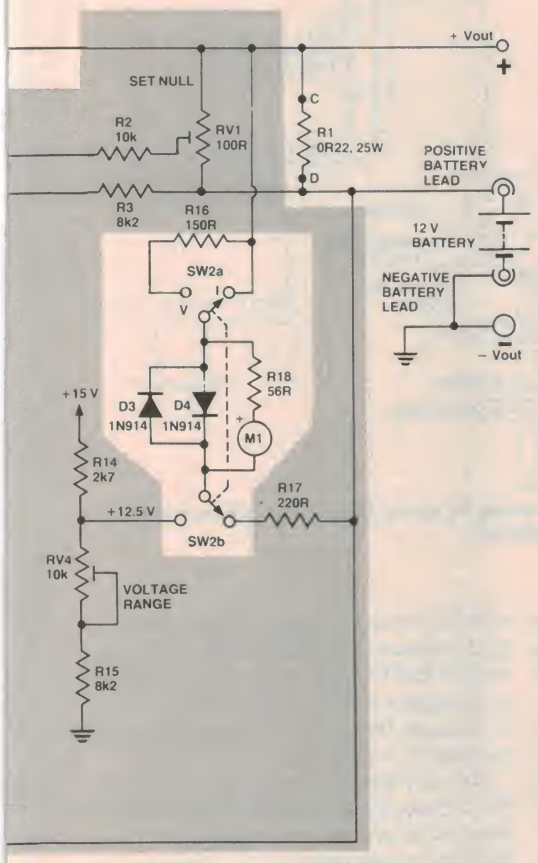
IC5 performs the logic necessary to control the relay. The first two gates (IC5a, IC5b) are coupled as a flip-flop. When the device is idle, the output of IC5a is high and the flip-flop is in the 'discharge' condition. The relay is held off by IC5c. If the battery is very flat, or if the wires are short-circuited, or the battery connected in reverse, IC5d holds the relay off irrespective of the flip-flop condition. When the battery is connected and is only normally discharged, and when the flip-flop is in the charge condition, IC5c turns Q1 on and the relay pulls in connecting the battery to the unregulated supply, again via R1 (permitting actual V_{out} to be measured) and via the light globe, which effectively regulates the current. (More on this in a moment).

IC1 simply provides a voltage reference of about 15 volts, as well as a regulated supply for IC3, IC4 and IC5. The meter and surrounding components provide a convenient 15-0-15 amp current meter and a 10-15 volt suppressed zero voltmeter, which reads the voltage delivered to the load.

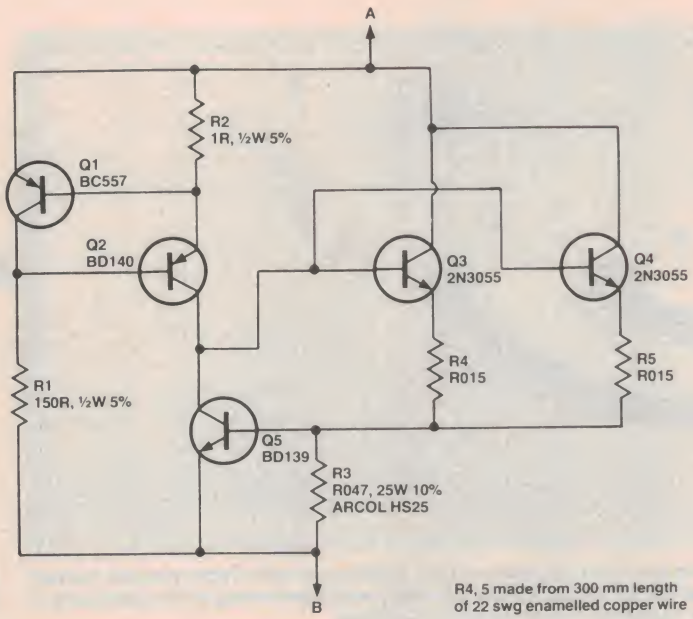
When the battery open-circuit potential falls to below the preset limit (10.8 V), IC3 toggles the flip-flop and RL1 pulls in. The charge current flows until the output of IC4 goes high, toggling the flip-flop back to the original state and turning the relay off. While charging, the current is effectively regulated by LP1 (a 6 V, 45 W light globe). The globe exhibits a characteristic of $I \propto V^2$, which tends to hold the current at around 5-6 A after it warms up. Initial charging current will be higher. This method of current regulation is by far the cheapest, and causes no RFI, etc. In case anyone should experience trouble getting such a globe, such as might be the case if you do not have a Volkswagen parts place nearby (many old VWs have 6 V headlights), we have included a circuit which can be substituted. It is at once clear how much nicer is the globe approach!

LIGHT GLOBE SUBSTITUTE

Transistors Q1 and Q2 form a current source, feeding about 600 mA out of the collector of Q2. This turns on Q3 and Q4 until 0.6 volts is dropped across the R047 resistor, R3. At this point, Q5 turns on and removes the excess drive current from Q3/4, regulating the current in this fashion. The two R015 resistors, formed by about 300 mm of 22 swg each, ensure that Q3 and Q4 share the load roughly equally. Q3 and Q4 must be mounted on a suitable heatsink.



The circuit is fairly straightforward. The M-2000 transformer (T1) is rated to deliver 6 A at 18 V. However, it will deliver more than twice the output current for short periods, without distress, and we've taken advantage of that. The secondary voltage loads down somewhat, but that's been taken into account. Note that the relay has its contacts paralleled.



R4, 5 made from 300 mm length of 22 swg enamelled copper wire

Circuit of the light globe substitute.

cables, which ran to the bolt-on battery terminals, rather than the alligator clips usually found on battery chargers and jumper leads. This minimised resistance and hence voltage drop with heavy load currents. The voltage sensing circuitry expects a low resistance path to the battery, so this arrangement is by far the best.

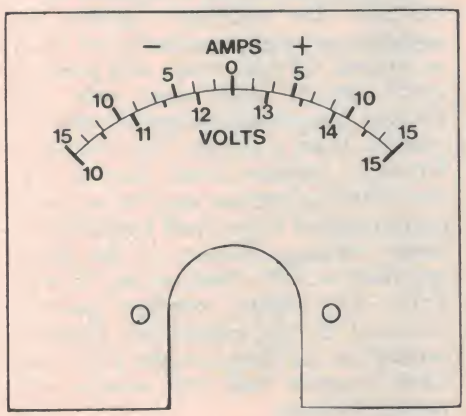
The leads connecting transformer, diode bridge, lamp and output terminals need to be fairly heavy, but not so heavy as the battery leads — ordinary automotive hookup wire (32 x 0.2 mm) or 1.5 mm tinned copper wire in spaghetti is quite adequate.

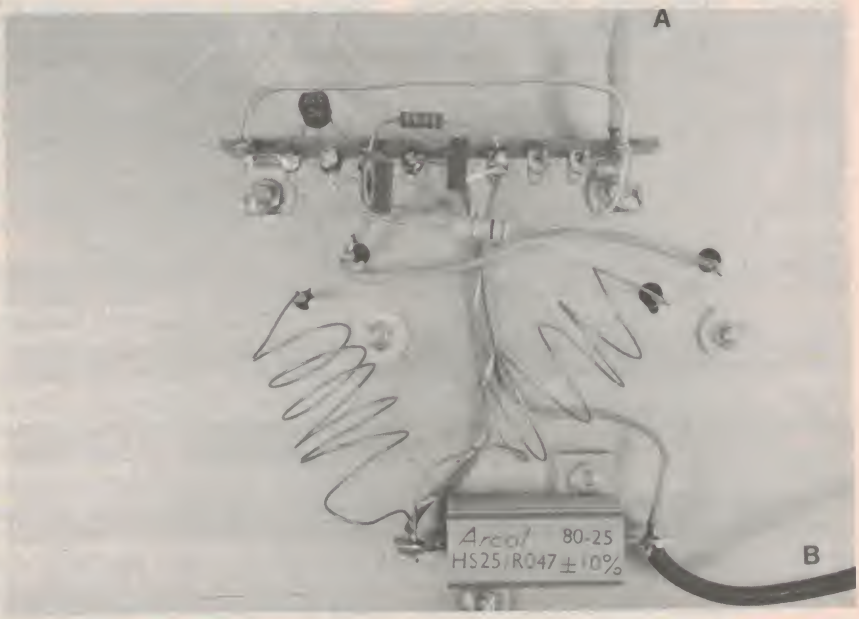
Follow the interconnection diagram to complete the circuit. If you like, a large and chunky bezel can be fitted to an appropriate part of the front panel so that it is illuminated by the globe when the unit is charging.

We felt this to be a little superfluous as light streams out of the ventilation slots!

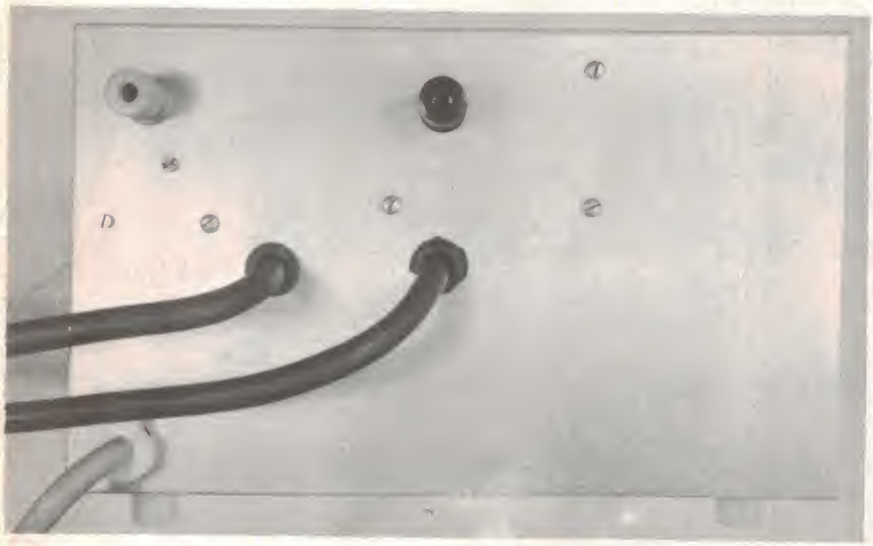
The mains wiring should be installed ▶

Full-scale artwork for the TD-66 1-0-1 mA meter. University Graham Instruments will be supplying meters for this project with this scale fitted.

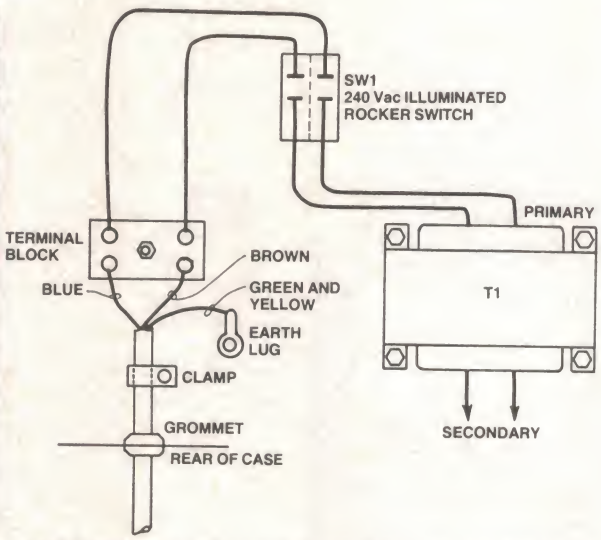




Construction of the light globe substitute circuit. Layout is not critical.



View of the rear panel (exciting, isn't it!), showing the mains cable entry and the two battery cables. The output terminals to supply equipment running off the batteries are at the top, positive on the left, negative on the right.



Mains cable wiring. Be sure to sleeve all exposed connections for your own protection.

with care, the mains input lead being physically 'shielded' from the pc board by a cardboard 'screen'.

For those people with no access to a VW dealer or other source of suitable 6 V globes, we have provided a tested current regulator circuit. We constructed ours using a tag strip which bolted neatly on to the power transistor collector connections (see pic, p. 41). This is a last resort, as it is more costly and less easy to install than a simple lamp, and demands some sort of careful heatsinking. We built ours on a separate small sheet of 1 mm thick aluminium, though there is no reason why you should not use a panel of the box if physically convenient. We mounted two pre-drilled heatsinks to the transistors to dissipate most of the heat. Be sure to fit the 2N3055s carefully, removing burrs which might puncture the insulating washers and using adequate thermal compound. The value of the two R015 resistors (R4, R5) is not critical, though care should be taken to ensure that they are equal in value as their function is to make the two transistors share the load. We made them with about 300 mm of 22 swg enamelled wire each.

Setting up

Once construction is completed, the unit may be set up for correct operation after you have carried out a *thorough* wiring check.

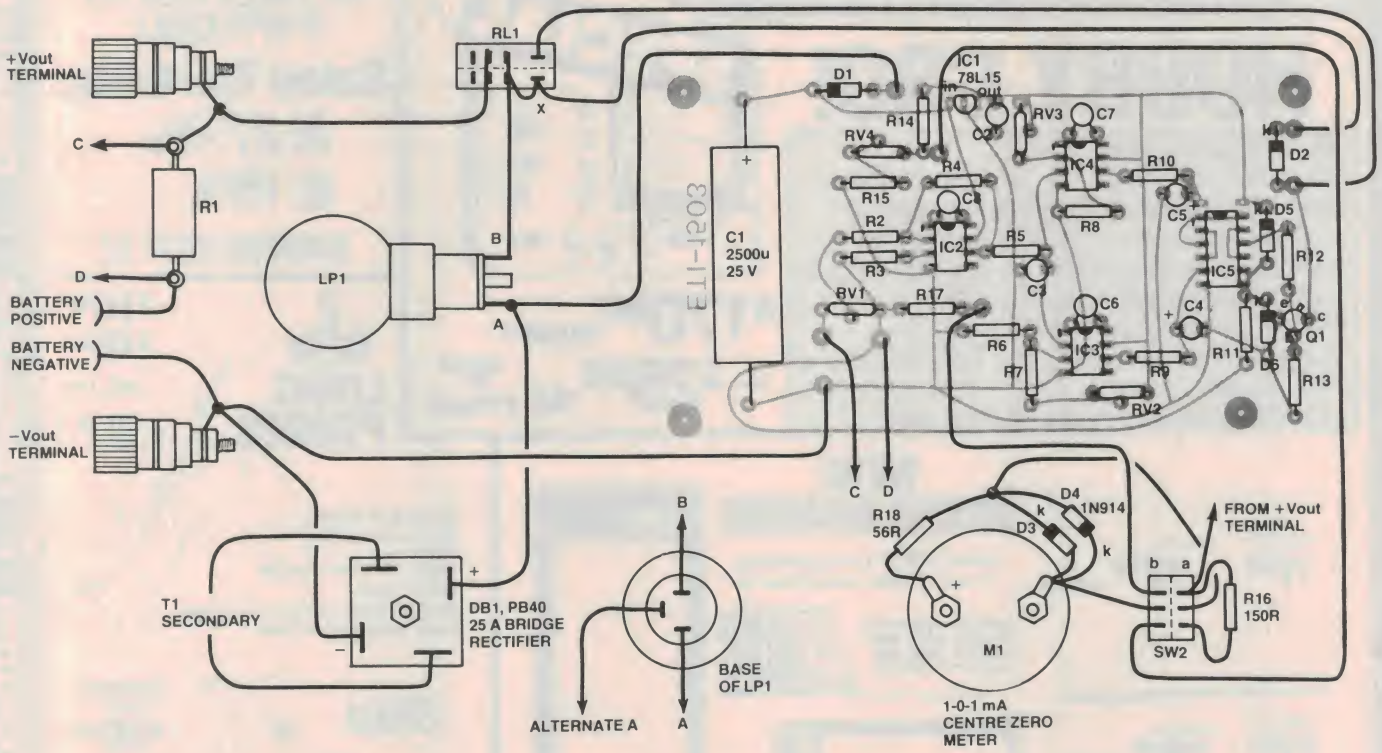
Fit a battery which is not very flat and turn the unit on. It may come on in the charge mode or it may be dormant, depending on the actual battery terminal voltage. To set the charger up you will need a multimeter with a sensitivity of at least 20k/volt.

First, operate the meter switch so that the meter reads volts (V). Connect your multimeter across the output terminals on the rear of the case, set it to read volts, and adjust RV4 so that the front panel meter reads the same voltage as the multimeter. Once RV4 has been adjusted, connect your multimeter (still on the same range) between pin 2 of IC4 (multimeter positive lead) and 0 V (black output terminal). Adjust RV3 so that your multimeter reads 14.0 to 14.1 volts here. This adjusts the point where the charger turns off ('STOP CHARGE'). Next, connect your multimeter between pin 3 of IC3 (multimeter positive lead) and 0 V, and adjust RV2 to obtain about 10.8 to 10.9 volts here. This sets the point where the charger turns on ('START CHARGE').

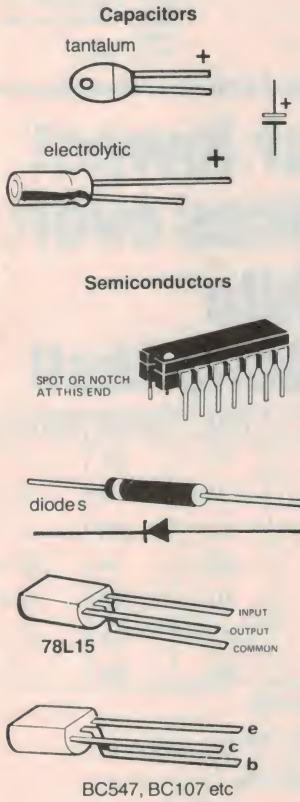
Finally, the unit needs to be adjusted to compensate for the internal resistance of the battery. This adjustment is simple, but will need to be done for each different battery with which the unit is used. If the unit is charging initially it may be best to toggle it off for convenience. This is most easily accomplished by momentarily connecting the positive end of C5 to the 15 V supply ('out' pin of IC1). Next, connect a load of a few amps to the charger's output terminals, either via a switch or flying leads so that you can connect and disconnect it. Then adjust RV1 so that no change in voltage occurs on the output of IC2 (pin 6) when the load is connected or disconnected. This should not be done with a flat battery — i.e: if the unit goes to charge mode at initial switch-on, let it charge for a few hours before completing the calibration.

Strictly speaking, the recalibration of RV1 does not need to be redone for any new battery connected, especially if the battery is just going to be left alone and is not intended for back-up work, such as a burglar alarm battery. The internal positive lead resistance will be roughly similar for similar capacity batteries, so this can be neglected if you are only leaving the battery on for a short while, as might be the case if you transfer the car battery onto the charger for a day or a few days. However, RV1 should be recalibrated if the installation is to be considered permanent or if the batteries are very different in capacity.

The charger was designed to be used with batteries having a capacity up to 100 AH. The smallest capacity car batteries generally available are rated at around 32 AH. They will perform quite happily when used with this charger, though the charging current is greater than optimum. For batteries having a capacity lower than 40 AH, the charging current may be conveniently reduced if you wish by using the lower wattage filament in the globe specified for LP1. Connect the 'A' lead from the bridge rectifier positive terminal to the alternative filament connection as shown in the LP1 Base Lead diagram with the overlay and wiring diagram. ●



COMPONENT PINOUTS



PARTS LIST — ETI-1503

Resistors — all ½W, 5% unless noted

R1	R022, 25 W (Arcol, metal clad type)
R2,R5,R7,R11	10k
R3,R15	8k2
R4	39k
R6, R8	27k
R9,R10	270k
R12	4k7
R13	2k2
R14	2k7
R16	150R
R17	220R
R18	56R

Capacitors

C1	2500u/25 V electro.
C2,C4,C5	10u/16 V tantalum or RBLL
C3	150n
C6,C7,C8	1n ceramic

Semiconductors

D1	1N4001 or similar
D2-D6	1N914 or similar
DB1	25A bridge rectifier
IC1	78L15 3-terminal regulator
IC2,IC3,IC4	LM301
IC5	4001
Q1	BC107, BC547 etc

Miscellaneous

RV1	100R trimpot
RV2, RV4	10k trimpot
RV3	5k trimpot
M1	1-0-1 mA centre-zero panel meter
RL1	12 V SPST relay with 10 A contacts or DPST with 5 A contacts.
LP1	6V, 45 W or 50 W Volkswagen headlamp globe
T1	240 V to 17-18 V transformer, 6 A secondary (i.e: DSE M-2000)
SW1	Rocker switch, 240 Vac rated with neon illumination.
SW2	Spring-return action DPDT toggle switch

Case — 255 x 160 x 160 mm or similar (e.g: K&W Series C1066); ETI-1503 pc board; wire; mains cable clamp, mains lead and plug; battery cables and clamps; one red and one black heavy duty terminals.

Supplementary parts — substitute for LP1

Q1	BC557 etc.
Q2	BD140
Q3,Q4	2N3055
Q5	BD139
R1	1R, 1 W
R2	150R, ½W
R3	R047, 25 W (Arcol, metal clad type)
R4,R5	see text.

Transistor insulated mounting components, heatsinks, nuts, bolts, etc.

Price estimate

We estimate that the cost of purchasing all the components for this project will be in the range:

$78 - $86

Note that this is an **estimate** only and **not** a recommended price. A variety of factors may affect the price of a project such as — quality of components purchased, type of pc board (fibreglass or phenolic base), type of front panel (if used) supplied etc — whether bought as separate components or made up as a kit.

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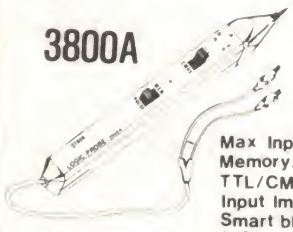

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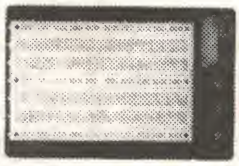

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IN 4007	.12	.09	.07 B
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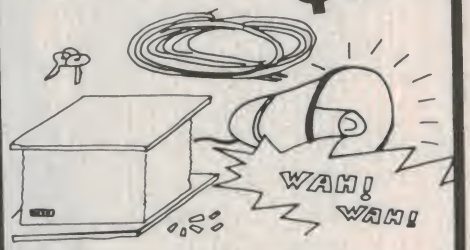

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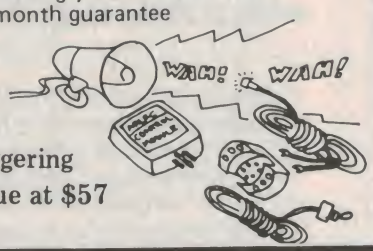

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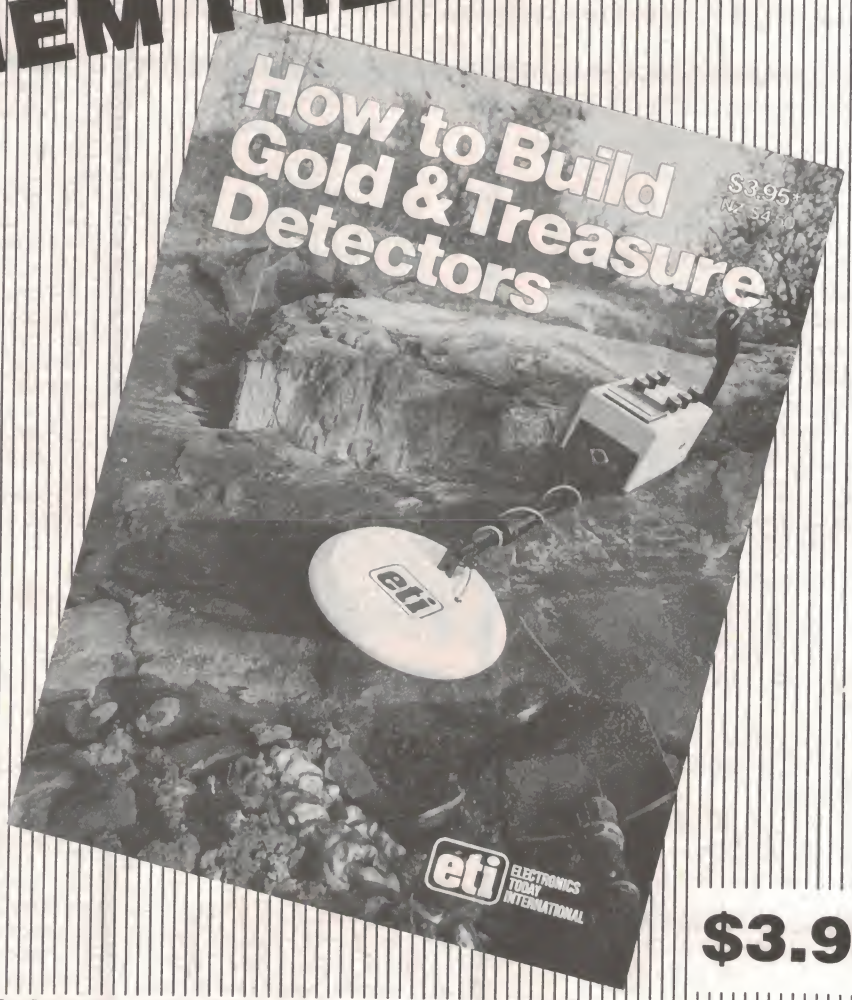

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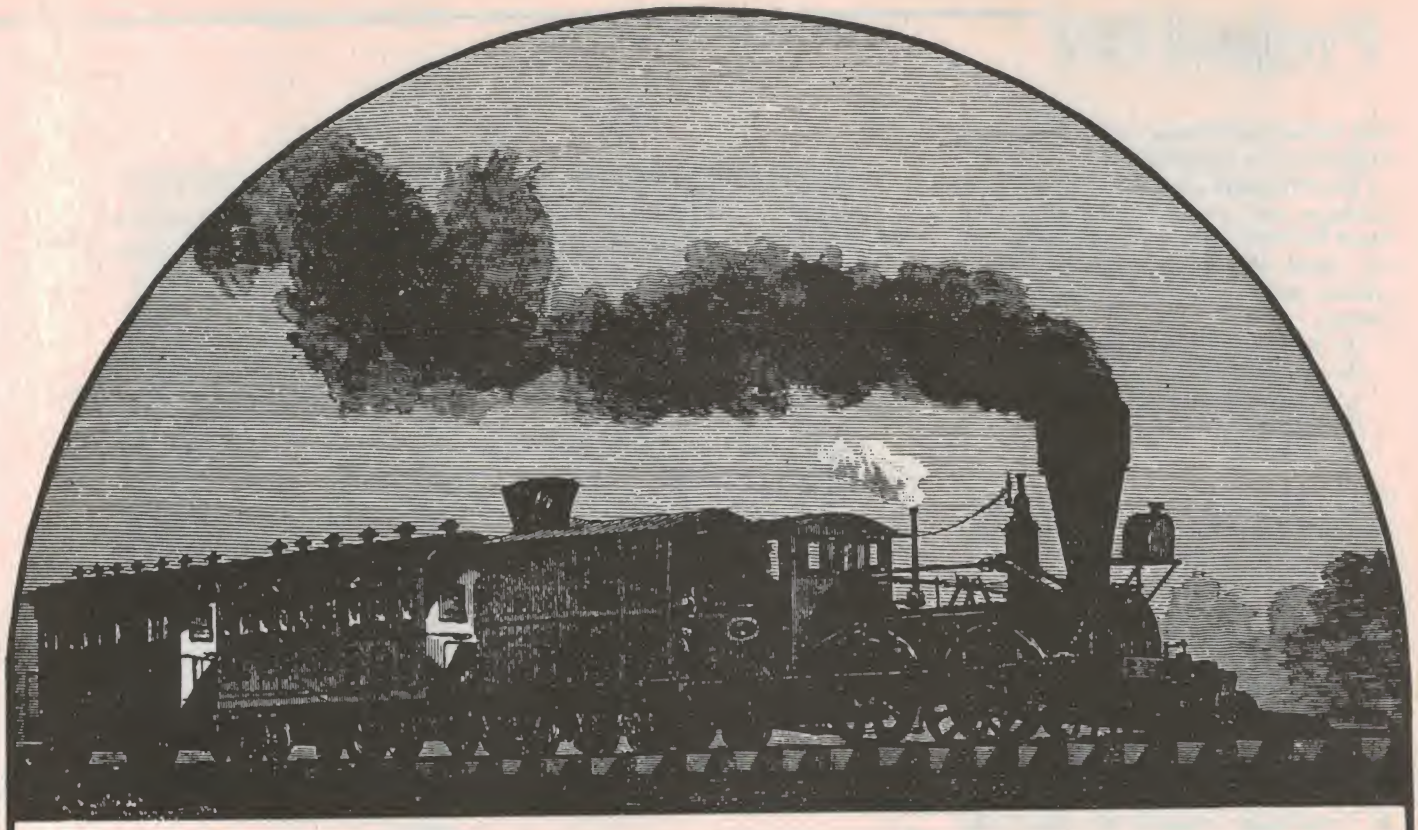


Simple sound effects

Phil Wait **Part 1**

One of the attractions of the more sophisticated video games seen in 'fun' arcades these days is the realistic array of sound effects that go with the action — gunshots, bomb whistles and explosions, etc. This simple group of projects employs just one IC that does all the hard work.

THOSE 'CANNON SHOTS' and explosions that go with the popular 'Space Invaders' video games and its variants add a measure of interest, feedback and stimulation to the action in which you participate on screen. Those sounds are electronically synthesised — that is, they consist of a complex mixture of waveforms that make up the required sound.

A 'bomb drop and explosion' is a remarkably complex sound when analysed carefully. Looking at it simply, there is a descending tone followed by a burst of noise that dies away in intensity. The descending tone starts at quite a high pitch and is not a 'pure' tone (i.e: a sine wave). The explosion is a burst of noise that commences suddenly and dies away slowly in a recognisable way (usually exponentially). While it is possible to electronically produce very nearly an exact replica of a bomb drop and explosion, some compromises are acceptable to reduce the complexity and cost of the task and yet produce a recognisable replica of the sound.

To produce such sound using conventional components — transistors, diodes, op-amps, resistors and capacitors — would require a whole legion of components. Fortunately, the IC manufacturers can come to our rescue here and much of the circuitry can be incorporated into a complex integrated circuit requiring the addition of a minimum of external components and the appropriate interconnections to synthesise the required sound. Generating a wide variety of sounds fortunately requires only a limited number of functional blocks, such as: a noise generator, voltage-controlled oscillators, multivibrators, envelope generators (a sort of modulator), mixers and amplifiers.

Texas Instruments, the giant US-based component and equipment manufacturer, have designed a series of complex function ICs for various applications and amongst them is the SN76488 Complex Sound Generator. This chip contains both linear and digital circuitry and is intended for use in applications requiring audio feedback to the user — video games, pinball, alarms, toys, etc, or industrial indicators, feedback controls and the like. Power consumption is quite low, allow-▶

ing battery operation, and only a single supply rail is required.

The SN76488 is contained in a 28-pin package and can be purchased for less than $10. It is quite a versatile chip, but we have chosen to describe how to obtain only five sounds effects, these being:

(a) bomb drop and explosion
(b) steam train and whistle
(c) alarm ('phasor')
(d) phasor and explosion
(e) gunshot

The first three are described this month, the last two will follow next issue. Only one pc board is required for all five projects. Before going on to the general construction details, let us take a look at what's inside the SN76488 and what each function block does. Not every function block inside the IC is used to produce each sound, so it is necessary to learn what each does before you can understand how individual sounds are produced or how you can use the chip to synthesise sounds for your own requirements.

Inside the SN76488

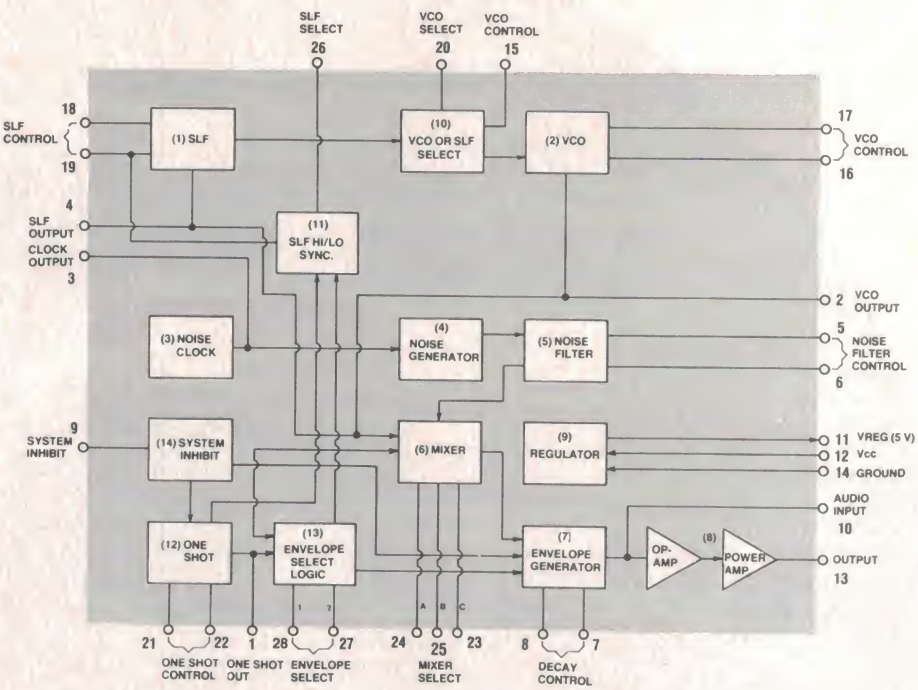
There are 14 functional circuit blocks contained within the IC.

(1) super low frequency oscillator (SLF)
(2) voltage-controlled oscillator (VCO)
(3) noise clock
(4) noise generator
(5) noise filter
(6) mixer
(7) envelope generator
(8) op-amp and power amp
(9) regulator
(10) VCO/SLF select
(11) SLF hi/lo synchroniser
(12) one shot
(13) envelope select
(14) system inhibit

Note that blocks one to four can be considered the basic *sound generators*, blocks five, six and seven are *sound modifiers*, while block eight provides the *output* and block nine distributes the power supply. Blocks 10 to 14 *control* the other functions.

(1) The SLF

This is an oscillator that can operate over the range from 0.1 Hz (one cycle every ten seconds) to 20 kHz, but it is not normally used at frequencies above about 30 Hz. The frequency of oscillation is determined by a resistor and capacitor, the resistor from pin 18 to 0 V, the capacitor from pin 19 to 0 V.



Internal block diagram of the SN76488.

The required frequency can be determined from the following formula:

$$SLF\ (Hz) = \frac{0.66}{(9000 + R_s)\,C_s}$$

where: R_s is resistor on pin 18
C_s is capacitor on pin 19

The SLF produces a square wave with a 50% duty cycle (high and low for equal periods) and a triangular wave. The square wave is internally connected to the mixer (6) and is available as an output on pin 4. The triangular wave goes to the VCO/SLF select block (10).

(2) The VCO

This is an oscillator which can be swept over a 10:1 frequency range by either the SLF output or an externally applied voltage (via pin 15 and the VCO/SLF select). Control of the VCO via the VCO/SLF select is discussed in (10).

The VCO can also be controlled by varying the voltage on pin 19 (SLF control, capacitor pin). The minimum frequency of the VCO is set by a resistor between pin 17 and 0 V and a capacitor between pin 16 and 0 V. The maximum frequency will always be 10 times the minimum frequency. The required minimum frequency can be derived from the following equation:

$$VCO_{min.}\ (Hz) = \frac{0.6}{(9000 + R_l)\,C_l}$$

where: R_l is resistor on pin 17
C_l is capacitor on pin 16

The output from the VCO is a square wave, available on pin 2. Internally, the VCO output is applied to one input of the mixer (6).

(3) Noise clock

This is an oscillator that feeds timing pulses to the noise generator (4), which generates pseudo-random noise digitally. The noise clock operates at a frequency of about 10 kHz and its output is available on pin 3. This output can be used for multiplexing.

(4) Noise generator

This is a digital circuit that produces pseudo-random white noise. The output is not directly available on one of the IC pins, being passed internally to the noise filter.

(5) Noise filter

This is a variable bandwidth low pass filter. The filter cutoff point is determined by an RC network consisting of a resistor between pin 5 and 0 V, and a capacitor between pin 6 and 0 V. The cutoff frequency is determined by:

$$F_c\ (Hz) = \frac{0.43}{(9000 + R_c)\,C_c}$$

where: R_c is the resistor on pin 5
C_c is the capacitor on pin 6

The output of the noise filter feeds an input to the mixer (6).

(6) Mixer

The mixer selects one or a combination of the inputs from the VCO, SLF or noise generator (via the filter), its output passing directly to the envelope generator. The mixer has three 'select' terminals, pins 23, 24 and 25, permitting eight output combinations according to Table 1. A 'low' (L) or a 'high' (H) on the appropriate pins

Mixer Select Inputs			Mixer
C (Pin 23)	B (Pin 25)	A (Pin 24)	Output
L	L	L	VCO
H	L	L	SLF
L	H	L	NOISE
H	H	L	VCO/NOISE
L	L	H	SLF/NOISE
H	L	H	SLF/VCO/NOISE
L	H	H	SLF/VCO
H	H	H	INHIBIT

Table 1. Mixer Select logic.

Envelope Select 1	Envelope Select 2	Selected Function
Pin 28	Pin 27	
L	L	VCO
L	H	Mixer Only
H	L	One-Shot
H	H	VCO with AC

Table 2. Envelope Select logic.

activates the selection. A low is 0 V, a high is +5 V.

The mixer performs as an AND gate, actually. To obtain two sounds simultaneously, multiplexing is required. This is accomplished by switching the mixer select lines at a sufficiently rapid rate that the two sounds seem to occur simultaneously. To prevent interaction with the sound output, the multiplexing rate is usually set above the human hearing frequency range. To provide equal amplitudes for both sounds the multiplexing drive signal must have a 1:1 duty cycle.

(7) Envelope generator

This block modulates the mixer output to give the sound the required 'decay' characteristics. The sound from the mixer can be made to die away (decay); the length of time it takes to do so is determined by an RC network connected to the 'decay control' pins — a resistor between pin 7 and 0 V and a capacitor between pin 8 and 0 V.

The decay is actually a ramp at the end of the sound. The approximate time it takes to ramp the sound amplitude to zero may be derived from:

$$\text{Decay (seconds)} = 1.5(9000 + R_d)C_d$$

where: R_d is resistor on pin 7.
C_d is capacitor on pin 8

The decay has no effect on the mixer-only function, but for the one shot, the VCO, and the VCO with alternating cycle envelopes, the decay ramp is triggered by each high-to-low transition of the envelope and prolongs the sound at a decaying volume.

(8) Op-amp and power amp

This provides the audio output. The op-amp brings the level out of the envelope generator up to that required by the power output stage, the latter providing 125 milliwatts maximum to an eight ohm speaker. A higher impedance speaker can be used, with reduced output power, but a four ohm speaker is not suitable.

The input to the op-amp is accessible on pin 10 and an externally produced audio signal may be mixed in at this point. Coupling to this input should be via a capacitor.

(9) The regulator

An internal 5 V regulator is provided and it can operate from a supply rail of between 7.5 and 10 volts, connected with the positive to pin 12, negative (0 V) to pin 14. This conveniently permits operation of the SN76488 chip from a 9 V battery. The 5 V regulator output is accessible on pin 11 and can supply up to 5 mA current.

(10) VCO/SLF select

The VCO can be swept by the SLF or an external signal applied to pin 15 (VCO control). Pin 20 controls the operation of this logic block, which is in effect a switch. A high on pin 20 permits the VCO to be controlled by the SLF, a low permits the VCO to be controlled by the external voltage or signal, applied to pin 15.

The frequency of the VCO is inversely proportional to the voltage on pin 15. The higher the voltage, the lower the VCO frequency. Voltages above 2.35 V applied to pin 15 will produce an inaudible frequency from the VCO's output.

(11) SLF hi/lo synchroniser

This block permits control of the SLF by the one shot (12) and the envelope select (13). The SLF can be inhibited at any time by applying a logic low to pin 26.

(12) One shot

A high-to-low transition on pin 9 triggers 'one shot' sounds such as a gunshot or explosion. The maximum duration of a one shot sound is about 10 seconds and is determined by an RC network; a capacitor between pin 21 and 0 V and a resistor between pin 22 and 0 V. The duration can be determined from the formula:

$$\text{Duration (seconds)} = 0.91\,(R_d + 9000)\,C_d$$

where: R_d is the resistor on pin 22
C_d is the capacitor on pin 21

If the one shot is terminated early by taking the system inhibit high, the one shot timing must be allowed to end so that an internal latch will be reset before another one shot can be triggered. The one shot may also be controlled by external logic eliminating the need for the one shot resistor and capacitor. This is done by triggering the one shot in the normal way with the system inhibit input, and terminating it by taking pin 21 (one shot capacitor) high.

The output of the one shot is fed through the envelope select logic to the envelope generator, and is therefore operable only when the one shot envelope is selected by the envelope select inputs. The one shot does not generate sound as such, but provides an envelope for the sound supplied to the envelope generator by the mixer.

A one shot output pulse is available at pin 1. In the one shot mode, the SLF ramp can be started either high or low by placing a high or low on the SLF Sync Select, pin 26.

(13) Envelope select

This block determines how the envelope of sound is formed, whether directly from the signals applied to the mixer or from the one shot. Pins 27 and 28 control the operation of this block, and a combination of highs and lows determines which function is selected according to Table 2. The VCO output to the mixer can be selected (SLF inhibited), mixer only output (one shot inhibited), one shot and VCO plus other (ac) signals.

(14) System inhibit

The system inhibit logic provides inhibit/select control for the sound output of the system: a high logic level at the system inhibit terminal (pin 9) inhibits the sound output, a low logic level (or open) enables it. This input also triggers the one shot circuit for momentary sounds such as gunshots, bells, or explosions. The one shot logic is triggered on the negative-going edge of the system inhibit input. This may be accomplished by means of a momentary switch or by a square wave input to system inhibit. The system inhibit input must be held low for the entire duration of the one shot sound, including attack and decay periods if the sound is to be completed. Taking the system inhibit input high early terminates the sound. Note that the one shot is operable only when the proper envelope select logic is selected. ▶

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4557	2.24 B
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4561	1.50 B
4562	4.70 B
4566	2.25 B
4568	4.10 B
4569	2.40 B
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4581	2.63 B
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4724	1.05 B
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40175	1.04 B
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Z80CTC	6.95 B
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DS8629	4.91 B
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PHONE (03) 602 3282 - 602 3836 TELEX AA 37758 LSTRON

DS8820	1.98 B
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BU208	2.18 A
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MPSA05	.20 A
MPSA14	.24 A
MPSA42	.39 A
MPSA64	.45 A
MPSA70	.27 A
MPSA92	.43 A
MPS4356	.45 A
MPS6531	.45 A
MRF237	2.68 B
MRF238	12.27 B
MRF 450A	13.77 B
MRF454	29.50 B
MRF475	3.34 B
MRF901	1.88 B
TIP29A	.58 A
TIP29B	.63 A
TIP30A	.60 A
TIP30B	.63 A
TIP30C	.84 A
TIP31A	.56 A
TIP318B	.60 A
TIP31C	.62 A
TIP32A	.56 A
TIP32B	.62 A
TIP32C	.79 A
TIP33A	.90 A
TIP33C	1.48 A
TIP34A	1.15 A
TIP34B	1.20 A
TIP34C	1.73 A
TIP41A	1.04 A
TIP41C	1.28 A
TIP42A	1.04 A
TIP42B	1.04 A
TIP42C	1.43 A
TIP 110	.90 A
TIP115	.90 A
TIP120	1.17 A
TIP125	1.20 A
TIP127	1.18 A
TIP2955	1.06 A
TIP3055	.85 A
TT641	.12 A
U310	1.84 B
VN10KM	1.98 B
VN66AF	2.65 B
VN88AF	2.75 B
VMP4	24.90 B

ARRIVING JULY. NEW DIGITAL MULTIMETER
PUSH BAR OPERATION. 3½ DIGIT .5" LED
INC. TRANSISTOR H.F.E. TESTER.
10 MEG INPUT 10A D.C. CURRENT
1% ACCURACY **$62 PLUS 15% TAX IF APPLICABLE.**

IN4001	50V	1A	.06 B
IN4002	100V	1A	.05 B
IN4004	400V	1A	.07 B
IN4007	1000V	1A	.12 B
IN4148			.04 B
IN5060			.25 B
IN5404	400V	3A	.24 B
IN5408	1000V	3A	.28 B
STG/GT32			.22 B
G.I.G.	AVALANCHE		.26 B
G.I.M	AVALANCHE		.45 B
OA626-800			.52 B
BYX21L	400V	25A	1.80 B
BYX21R	400V	25A	1.80 B
BYX21L	200V	25A	1.70 B
IN60			.08 B
IN914			.04 B
IS426			.10 B
ITT210			.10 B
BA102			.54 B
BA217			.04 B
BAV			.30 B
MV104	V.CAP		.95 B
OA47	GOLD BOND		.30 B
OA90			.15 B
OA91			.16 B
OA95			.15 B
OA645	200V	1.5A	.14 B
MDA1010			1.00 B
BPW34			3.00 B
BPW50			1.50 B

VOLTAGE REGULATOR

78L05	+5v	100mA	.38 B
79L05	-5v	100mA	.70 B
7805	+5v	1.5A	.86 B
LM309K	+5v	1.5A	1.76 B
7805K	+5v	1.5A	1.76 B
7905K	-5v	1.5A	3.22 B
7905	-5v	1.5A	1.54 B
LM323K	+5v	3A	5.42 B
78H05	+5v	5A	7.10 B
78P05	+5v	10A	13.19 B
78L06	-6v	100mA	.38 B
7806	+6v	1.5A	.90 B
7806KC	+6v	1.5A	1.87 B
7906	-6v	1.5A	1.70 B
78L08	+8v	100mA	.38 B
7808	+8v	1.5A	1.05 B
7908	-8v	1.5A	1.54 B
7808K	+8v	1.5A	2.45 B
78L09	+9v	100mA	.38 B
78L12	+12v	100mA	.38 B
79L12	-12v	100mA	.80 B
LM342-P12	+12	.25A	.67 B
LM341-P12	+12	.5A	.75 B
7812	+12v	1.5A	.78 B
7912	-12v	1.5A	1.20 B
7812K	+12v	1.5A	1.87 B
7912K	-12v	1.5A	2.99 B
78H12	-12v	5A	6.10 B
78CBUC	+13.8v	2A	1.98 B
78CBK	+13.8V	2A	4.90 B
78L15	+15v	100mA	.38 B
79L15	-15v	100mA	.85 B
LM342-P15	+15v	.25A	.67 B
LM341-P15	+15v	.5A	.75 B
7815	+15v	1.5A	.90 B
7815K	+15v	1.5A	2.97 B
7915	-15v	1.5A	1.70 B
7915K	-15v	1.5A	2.82 B
78H15	+15v	5A	6.10 B
78L18	+18v	100ma	.38 B
7818	+18v	1.5A	.90 B
7918	-18v	1.5A	1.70 B
7818K	+18v	1.5A	2.95 B
78L24	+24v	100MA	.38 B
79L24	-24v	100mA	.70 B
7824	+24v	1.5A	1.30 B
7924	-24v	1.5A	1.70 B
LM317T	+var	1.5A	1.45 B
LM337T	-var	1.5A	1.75 B
LM317K	+var	1.5A	2.66 B
LM337K	-var	1.5A	3.13 B
LM317L	+var	100mm	.68 B
LM317	Hi+var	1.5A	5.20 B
LM337	Hi-var	1.5A	8.33 B
LM338K	+var	5A	5.75 B
78HGK	+var	5A	7.15 B
LM350K	+var	3A	5.10 B
79MG	+var	0.5A	1.32 B

SCRS

C106A	100v	4A	.60 B
C106F1	50v	4A	.60 B
C106B1	200v	4A	.64 B
C106B	200v	4A	.65 B
C106D1	400v	4A	.67 B
C106E1	500v	4A	.91 B
C106Y	30v	4A	.60 B
C122D1	400v	4A	1.17 B
C122E	600v	8A	1.57 B
T1C146	100v	.6A	.65 B
EC1038B	200v	.84A	.48 B
EC103D	400v	.84A	.53 B
S2003LS2	200v	3A	.60 B
Q6010S5	600v	10A	1.60 B
S4010LS2	400v	10A	1.67 B
S6010L	600v	10A	1.67 B
S2015L	200v	15A	2.80 B
S4015L	400v	15A	3.00 B
S6015L	600v	15A	3.43 B

TRIACS

S2025H	200v	25A	5.10 B
S4025H	400v	25A	6.40 B
S4006LS2	400v	6A	1.15 B
C122D1	400v	8A	1.17 B
C122E	500v	8A	1.57 B
S6008L	600v	8A	1.65 B
S6025C	600v	25A	8.19 B
S2035H	200v	35A	5.50 B
S4035H	400v	35A	6.95 B
S6035C	600v	35A	9.22 B
S6035H	600v	35A	7.95 B
AC02DT	400v	2A	.50 B
Q6010L5	600v	10A	1.60 B
2N6073	400v	4A	1.20 B
Q4004L4	400v	4A	1.20 B
Q2006L4	200v	6A	.95 B
SC141D	400v	6A	.95 B
Q4006L4	400v	6A	.95 B
SC146D	400v	10A	1.50 B
Q4015L5	400v	15A	2.30 B
Q6015L5	600v	15A	2.90 B
Q4025H	400v	25A	5.50 B
Q6025H	600v	25A	6.75 B
Q4040D	400v	40A	8.64 B
Q4010L4	400v	10A	1.65 B
Q2015L5	200v	15A	1.80 B
Q6040D	600v	40A	10.88 B

LED+DISPLAYS

Red 5mm	.12 B
Green 5mm	.20 B
Yellow 5mm	.20 B
Orange 5mm	.20 B
MV5753 Red Wide beam	.34 B
MV5153 Orange Wide beam	.54 B
MV5353 Yellow Wide beam	.54 B
MV5752 Red Hi Intensity	.54 B
MV5352 Yellow Hi Intensity	.54 B
MV5152 Orange Hi Intensity	.54 B
MV5252 Green Hi Intensity	.54 B
LD271 Infra Red	.59 B
Green 3mm	.20 B
Red 3mm	.11 B
Yellow 3mm	.20 B
FND357cc 7-segment	1.55 B
FND358CA 7-segment	1.22 B
FND500cc 7-segment	1.20 B
FND507 CA 7-segment	1.39 B
FND800CC 7-segment	2.86 B
FND807CA 7-segment	2.86 B
MAN2A dot matrix	5.46 B
Red rectangular	.21 B
Green rectangular	.30 B
Yellow rectangular	.30 B
ME7121 infraRed Emit	1.65 B
ME7124 infraRed Emit	1.65 B
ME8020 infraRed Detector	.83 B
SEL351 Green 7-segment	.89 B
SEL151 Red 7-segment	.76 B
MAN54A .3" CC 7-seg Gn	3.05 B
MAN72A .3" CA DL707	1.47 B
MAN74A .3" CC DL704	1.47 B
MAN84A .3" CC 7-seg Yel	3.05 B
MAN3620A .3" CA 7-seg Or.	3.05 B
MAN3640 .3" CC 7-seg Or	3.05 B
MAN6640 .56" Or	4.65 B
MAN6660 .56" CA Or	2.94 B
MAN6680 .56" CC Or	2.94 B
MAN6740 .56" CC REd	3.17 B
MAN6760 .56" CA Red	2.03 B
MAN6780 .56" CC Red	2.03 B
MAN8610 .8" CA Orange	3.05 B
MAN8630 .8" CA Orange	3.05 B
MAN82A .3" CA Red	3.05 B
MAN8640 .8" CC Orange	3.05 B
LT303 .3" CC Red	1.30 B
LT302 .3" CA Red	1.30 B

BRIDGE RECTIFIERS

VM48	400v	1A DIL	.99 B
W02	200v	1.5A	.51 B
W04	400v	1.5A	.54 B
W06	600v	1.5A	.60 B
KBPC1022	200v	3A	.98 B
KBPC602	200v	6A	1.86 B
KBPC604	400v	6A	2.00 B
KBPC606	600v	6A	2.20 B
KBPC1002	200v	10A	2.78 B
VJ448	400v	10A	3.15 B
KBPC1004	400v	10A	3.05 B
KBPC1006	600v	10A	3.29 B
PK10F	400v	12A	2.60 B
MDA3501	100v	35A	2.73 B
MDA3502	200v	35A	3.00 B
MDA3504	400v	35A	3.30 B
KBPC35	600v	35A	3.50 B

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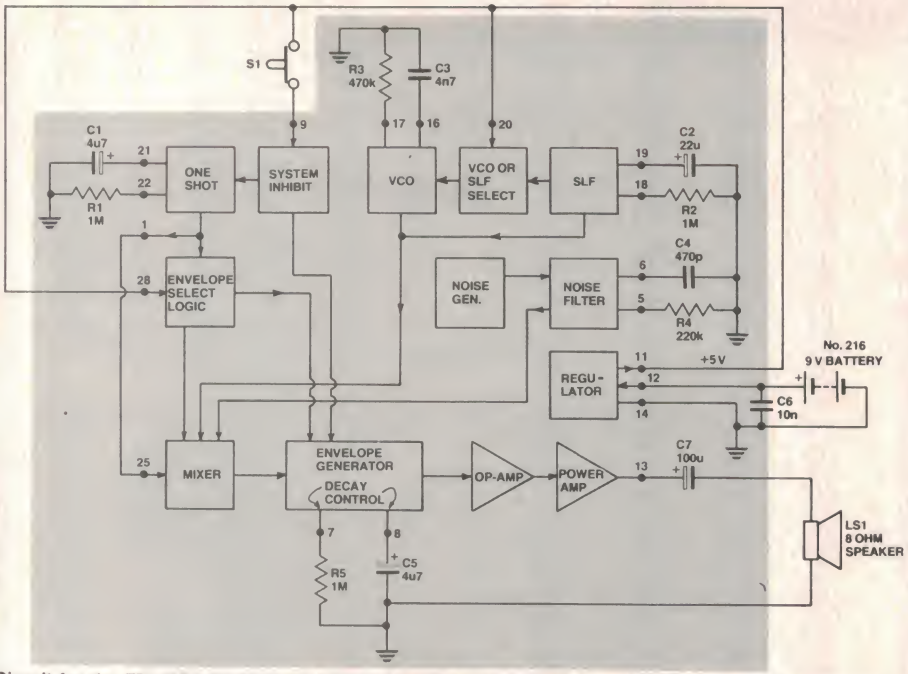


Circuit for the ETI-607A Bomb Drop & Explosion. The pushbutton is held down for the duration of the event. Release it and press again to repeat.

General construction

All the projects described use the one pc board design. As the SN76488 is available in two packages of different sizes and pin spacings — the A package, a conventional 28-pin package with 15.24 mm spacing between the pin rows and 2.54 mm pin spacing, and the smaller NF package having 10.16 mm spacing between the pin rows and 1.52 mm pin spacing — we have had to provide two pc board designs to accommodate the different packages. Each board is marked accordingly. Make sure you purchase the correct board to suit the device package you have. All the component pads and holes are in exactly the same position on each board and the overlay diagrams given in these articles apply to either board.

The SN76488 dominates the pc board. Only the required components are assembled into the board according to each overlay diagram to obtain the required sound generator. Naturally enough, the polarity of the IC should be noted as well as the polarity of electrolytic and tantalum capacitors used. Commence construction by assembling the passive components, followed by the IC. This is not a CMOS device and no special care is required, apart from being careful not to bend any pins under the device when inserting it. If you wish, a socket may be used for the IC. This way, you can assemble the five projects and purchase only one IC, swapping between the boards as you need to use them!

Wiring to the switches, the speaker and the supply should be attached last.

The unit may be mounted in any convenient-sized box and the speaker mounted on the front. Alternatively, it may be wired into an existing piece of equipment. We'll have to leave these arrangements up to you.

PARTS LIST — ETI 607A BOMB DROP + EXPLOSION

Resistors all ½W, 5%
- R1, R2, R5 ..... 1M
- R3 ..... 470k
- R4 ..... 220k

Capacitors
- C1, C5 ..... 4u7/16 V electro.
- C2 ..... 22u/16 V tant. or RBLL
- C3 ..... 4n7 greencap
- C4 ..... 470p ceramic
- C6 ..... 10n greencap
- C7 ..... 100u/16 V electro.

Semiconductors
- IC1 ..... SN76488

Miscellaneous
- S1 ..... SPST push-to-make pushbutton switch

ETI-607 pc board; 50 mm diameter 8 ohm speaker; No. 216 9 V battery and clip.

Price estimate

We estimate the cost of purchasing all the components for this project will be in the range:

$16 - $19

Note that this is an **estimate** only and **not** a recommended price. A variety of factors may affect the price of a project, such as — quality of components purchased, type of pc board (fibreglass or phenolic base), type of front panel supplied (if used), etc — whether bought as separate components or made up as a kit.

HOW IT WORKS — ETI 607A BOMB DROP AND EXPLOSION

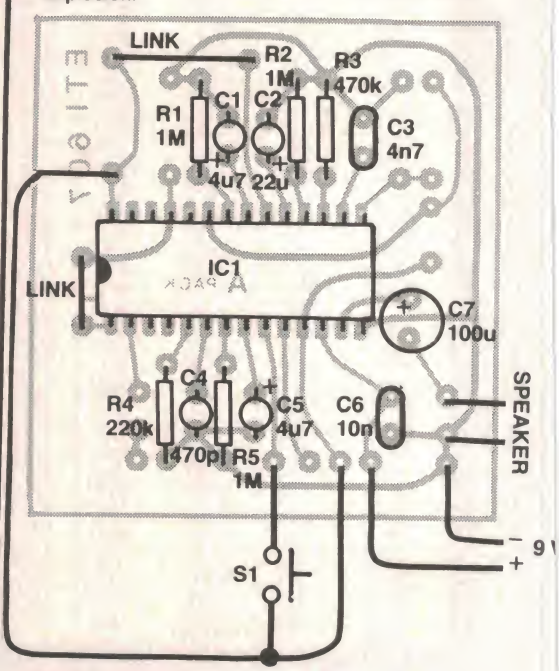
This unit employs most of the function block in the SN76488. The SLF provides a linearly increasing voltage waveform, or ramp, to the VCO, taking several seconds for the ramp voltage to rise from zero to maximum value. This causes the VCO to produce a tone which 'glides' down in pitch, making the 'bomb drop' effect. The explosion is generated by the Noise Generator/Filter and the Envelope Generator. It starts with a burst of noise, which dies away in intensity exponentially in a few seconds.

The whole sequence is triggered by operating the pushbutton, S1. This applies a high (+5 V) to the input of the System inhibit block, pin 9. This in turn triggers the One Shot and the Envelope Generator. At the commencement of the One Shot timing period, the One Shot triggers the SLF HI/LO Sync. (see SN76488 block diagram), starting the SLF, and the VCO does its thing. At the end of the One Shot timing period the Envelope Select Logic becomes operative, the SLF is disabled and the Envelope Generator commences to do *its* thing. The Mixer selects the VCO output at the start of the One Shot timing period and the Noise Generator/Filter output at the end of the One Shot timing period. Thus the two sounds are switched through to the audio output stage in sequence, the Envelope Generator modifying the noise so that it dies away, the time it takes to do so being controlled by the time constant of R5, C5.

The starting pitch of the VCO is determined by R3 and C3, the rate of rise of the voltage ramp produced by the SLF is determined by C2 and R2, while the One Shot timing period is determined by the time constant of C1 and R1. The frequency characteristics of the broadband noise produced by the Noise Generator are modified by R4 and C4 connected to the noise filter control pins (5 and 6).

Audio output is coupled to the loudspeaker via C7, a 100u electrolytic capacitor.

Component overlay for the ETI-607A Bomb Drop & Explosion.



PARTS LIST — ETI 607B STEAM ENGINE + WHISTLE

Resistors all ½W, 5%
- R1 ..... 330k
- R2 ..... 470k
- R3 ..... 56k
- R4 ..... 100k
- R5 ..... 1k

Capacitors
- C1 ..... 1u/16 V tant. or RBLL
- C2, C3 ..... 470p ceramic
- C4 ..... 10n greencap
- C5 ..... 100u/16 V electro.

Semiconductors
- IC1 ..... SN76488

Miscellaneous
- S1 ..... SPST push-to-make pushbutton switch;

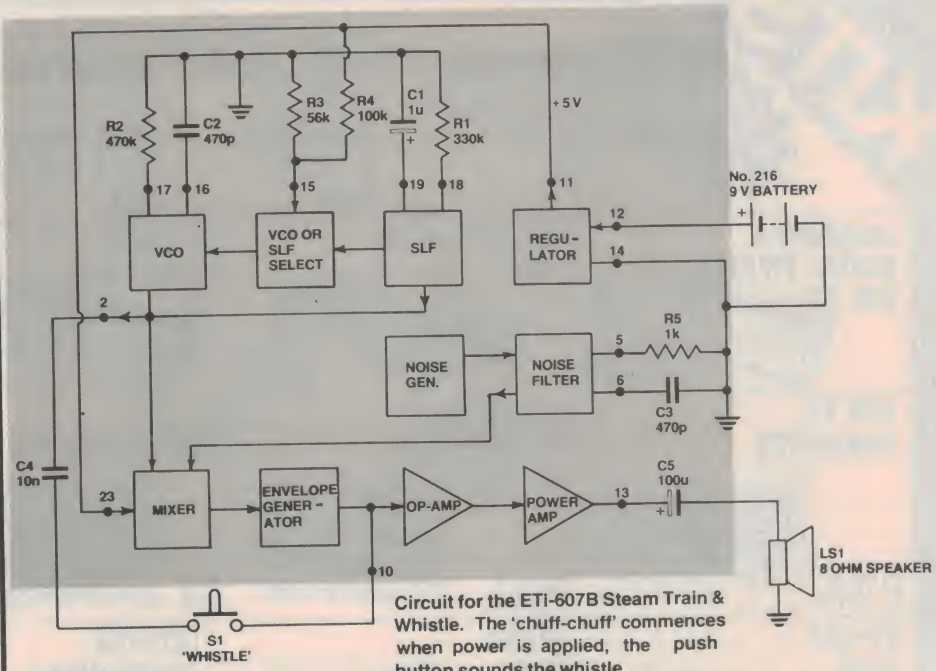
ETI-607 pc board; 50 mm diameter 8 ohm speaker; No. 216 9 V battery and clip.

Price estimate

We estimate the cost of purchasing all the components for this project will be in the range:

$14 - $17

Note that this is an **estimate** only and **not** a recommended price. A variety of factors may affect the price of a project, such as — quality of components purchased, type of pc board (fibreglass or phenolic base), type of front panel supplied (if used), etc — whether bought as separate components or made up as a kit.



Circuit for the ETI-607B Steam Train & Whistle. The 'chuff-chuff' commences when power is applied, the push button sounds the whistle.

HOW IT WORKS — ETI 607B — STEAM TRAIN AND WHISTLE

In this unit the Noise Generator/Filter is employed to produce the basic 'steam engine' sound, this being modulated by the SLF to produce the 'chuff-chuff' so characteristic of steam locomotives. The whistle is produced by the VCO, which is set to a particular non-varying pitch, and the output is switched into the audio input pin to produce the whistle.

The broadband noise from the Noise Generator is modified by the Noise Filter, the frequency characteristics being determined by R5 and C3 connected to the Noise Filter Control pins (5 and 6). The Noise Filter Output is fed via the Mixer and the Envelope Generator (which doesn't function here) to the audio output stages. The SLF square wave output effectively modulates the noise to produce a noise burst followed by a silent period, then another noise burst. Thus the chuff-chuff sound is produced. This sound is continuous whilst power is applied to the unit.

A resistive divider, R3/R4, provides about 1.8 volts at the VCO programming input, pin 15. This sets the VCO frequency to a convenient pitch within its range, providing a suitable pitch for the whistle. The VCO output is coupled to the audio input (pin 10) via C4 and the pushbutton, S1. When S1 is pressed, the whistle is heard over the chuff-chuff sound.

The SLF frequency is determined by C1 and R1, while the combination of R2/C2 and the voltage on pin 15 determines the VCO frequency. Output to the loudspeaker is coupled via C5, a 100u electrolytic capacitor.

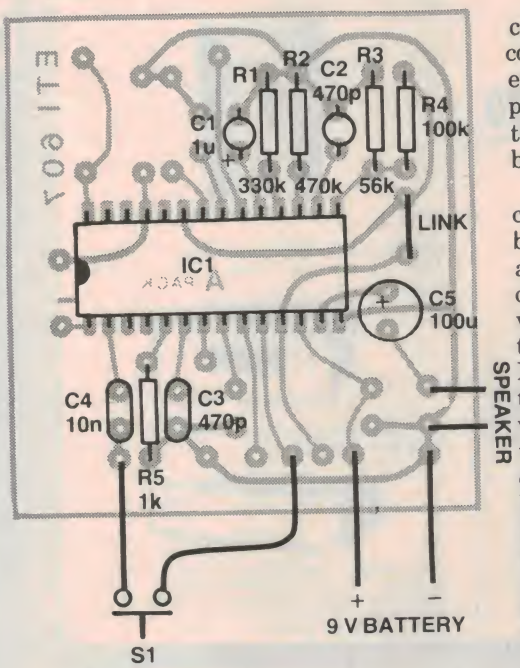
ETI-607A

This produces a 'bomb drop and explosion' sound at the press of a button. Alternatively, the pushbutton, S1, could be replaced by a pair of relay contacts operated by a piece of equipment or a transistor (emitter to pin 9, collector to other side of S1) that is turned on by a logic high applied to its base via a resistor.

This project is one of the most complex, using almost every functional block within the SN76488. Varying R3 and C3 a little will vary the pitch range of the 'bomb drop' (descending whistle), while varying R4 or C4 a little will vary the characteristics of the explosion. Note that it is generally easier to 'fine tune' things by varying the resistor values. The duration of the event can be varied by varying the value of either C1 or R1 and the decay of the explosion can be changed by varying R5 (varying C5 produces quite gross changes in the decay period).

Watch that you insert the link on the pc board in this one, located at the 'notch' end of the IC.

Component overlay for the ETI-607B Steam Train and Whistle.



ETI-607B

Aahh, the nostalgia! Clive Robertson (*), this is for you — a steam train (chuff-chuff) and whistle. For that *authentic* touch, deft constructors can fashion a cow-catcher out of tinned copper wire to attach to the unit!

The chuff-chuff runs continuously once power is applied and the whistle sounds when the pushbutton is pressed. The VCO is used to provide the whistle while the SLF modulates the noise generator/filter output to produce the steam train's chuff-chuff sound. The chuff-chuff rate may be varied by changing the values of R1 and C1, while the chuff-chuff sound may be varied by altering the values of R5 and C3. The pitch of the whistle may be varied by changing the values of R2 and C2. For a special effect, you can control the chuff-chuff rate manually by replacing R1 with a 1M potentiometer. ▶

**(In)famous breakfast announcer on ABC second network station 2BL in Sydney.*

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ETI 258 MINI DRILL CONTROL

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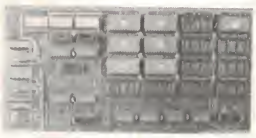

P.O.A.

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$11.00

ETI330 CAR ALARM

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ETI-156 INSTRUMENT PROBE

P.O.A.

ETI 458 LED LEVEL METER

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S100 Prom Board
ETI 682
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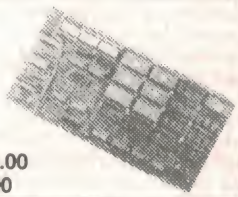
PCB $65.00



ETI 572 Digital PH Meter

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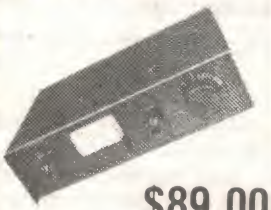
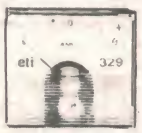
ETI 475 AM Tuner



$89.00

ETI 329 Expanded Scale Vehicle Ammeter



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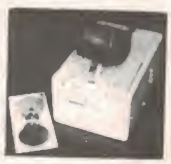

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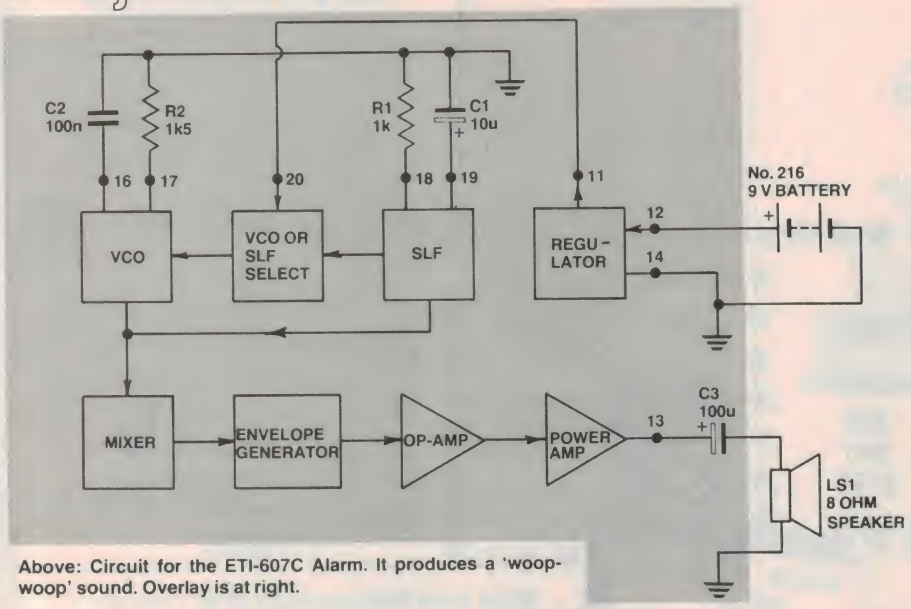


Above: Circuit for the ETI-607C Alarm. It produces a 'woop-woop' sound. Overlay is at right.

ETI-607C

The Texas Instruments' application notes include a 'phasor' circuit that produces a sound rather like a 'woop-woop' alarm. It's about the simplest project of the lot! The SLF is simply employed to sweep the VCO over a convenient range at a suitable speed. Turning the power supply on and off by inserting a switch or relay contacts in series with either the positive or negative battery leads serves to trigger the alarm. The VCO pitch may be varied to suit your requirements by changing the values of either C2 or R2, while the rate at which the VCO is swept may be varied by altering the value of either R1 or C1. ●

HOW IT WORKS — ETI 607C ALARM ('PHASOR')

This produces an alarm sound that's a real attention-getter! Operation is simplicity itself. The SLF is set to operate at a few cycles per second, determined by R1/C1. The ramp output of the SLF is selected to sweep the VCO by applying a high (+5 V) to the control input of the VCO/SLF Select block (pin 20). The VCO is thus swept across its range several times per second. Maximum frequency of the VCO is determined by R2/C2. Output from the VCO is coupled to the audio output stages via the Mixer and Envelope Generator (inoperative here). The speaker is connected via the obligatory 100u electrolytic capacitor, C3.

PARTS LIST — ETI 607C

Resistors all ½W, 5%
- R1 ..... 1k
- R2 ..... 1k5

Capacitors
- C1 ..... 10u/16 V electro.
- C2 ..... 100n greencap
- C3 ..... 100u/16 V electro.

Semiconductors
- IC1 ..... SN76488

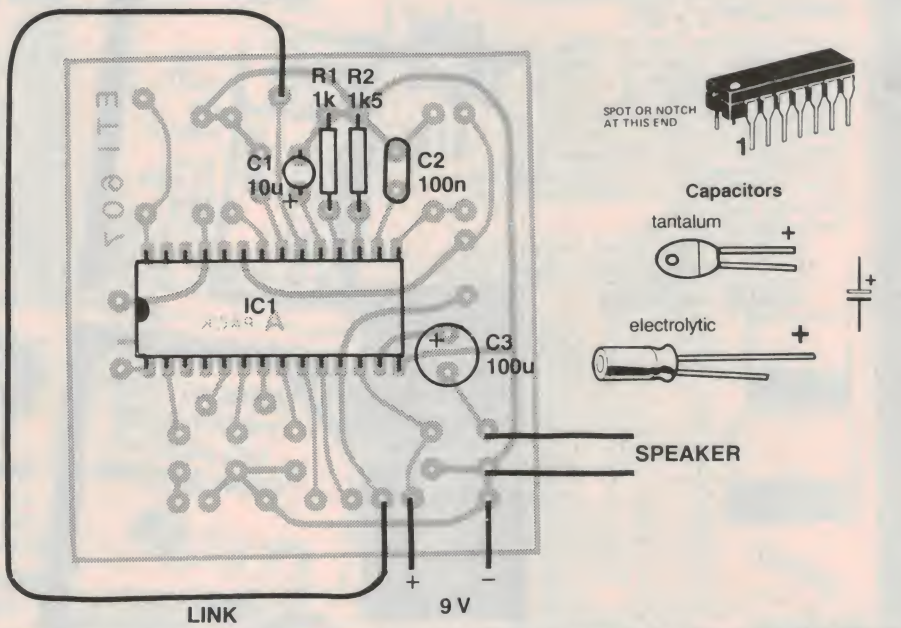
Miscellaneous
ETI-607 pc board; 50 mm diameter 8 ohm speaker; No. 216 9 V battery and clip; switch (if needed).

Price estimate

We estimate the cost of purchasing all the components for this project will be in the range:

$14 - $17

Note that this is an **estimate** only and **not** a recommended price. A variety of factors may affect the price of a project, such as — quality of components purchased, type of pc board (fibreglass or phenolic base), type of front panel supplied (if used), etc — whether bought as separate components or made up as a kit.



This photograph shows the Steam Train & Whistle built up. We leave the housing to you as individual requirements will vary.

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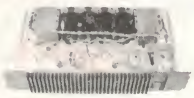

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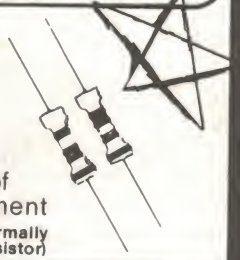

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Lab Notes

Remote control systems

Multi-channel remote control systems have many applications outside the radio control of models. Here, our correspondent illustrates a number of circuits that readers may find useful — all using commonly available components.

Ray Marston

SIMULTANEOUS multi-channel remote control systems, giving either fully proportional or simple on/off action (or a combination of the two) are widely used by the model plane, boat and car fraternities. Figure 1 shows the basic block diagram of an 8-channel version of the type of system in use.

In the transmitter, eight manually actuated pots (in a proportional system) or switches (in an on/off system) are sequentially sampled at a fixed rate by an encoder circuit, which at each sample point generates a pulse with a width proportional to the state of the device being tested. The output of the encoder consists of a repeating series of 'frames' of eight width-controlled pulses followed by a synchronisation pulse, all presented in serial form.

Typically, in an 8-channel proportional system, the width of the controlled pulses may be variable from 0.5 ms to 1.5 ms (depending on the settings of individual control pots), the sync pulse width may be 3 ms, the sample period 2 ms and the frame width 20 ms.

Servo code

The serial output of the encoder is coupled via a suitable 'link' to the input of a decoder circuit that is located in the remote receiver. The link may take the simple form of two wires (or only one if a ground return is used), or the more complex form of a modulated radio, ultrasonic, infrared, or magnetic signal, etc. The decoder circuit detects the sync pulse in each frame, and then counts the individual controlled pulses in the frame and routes each one to its own output terminal. There it may be fed to an electronic switch or a servo-mechanism which will reconstruct the original mechanical control movement that took place at the transmitter.

The 'heart' of the remote control system described above is the encoder and decoder. As already mentioned, the actual 'link' can take any one of a variety of forms The basic control system is highly versatile and has a vast number of untapped potential applications. The number of channels that can be simultaneously controlled can range from two to dozens (or even hundreds). In on/off applications, the outputs can easily be binary decoded to give non-simultaneous on/off control of a vast number of remote devices: an 8-channel system can, for example, control 256 devices, or a 12-channel system can control 4096.

The system can readily be adapted to give remote operation of lamp dimmers, volume controls, 'combination' locks and garage doors, or independent on/off control of hundreds of household fittings via signals pumped down the mains wiring. You can even, if it takes your fancy, use the system to remote control a full-sized piano from the comfort of an armchair via a hand-held keyboard and an infrared link!

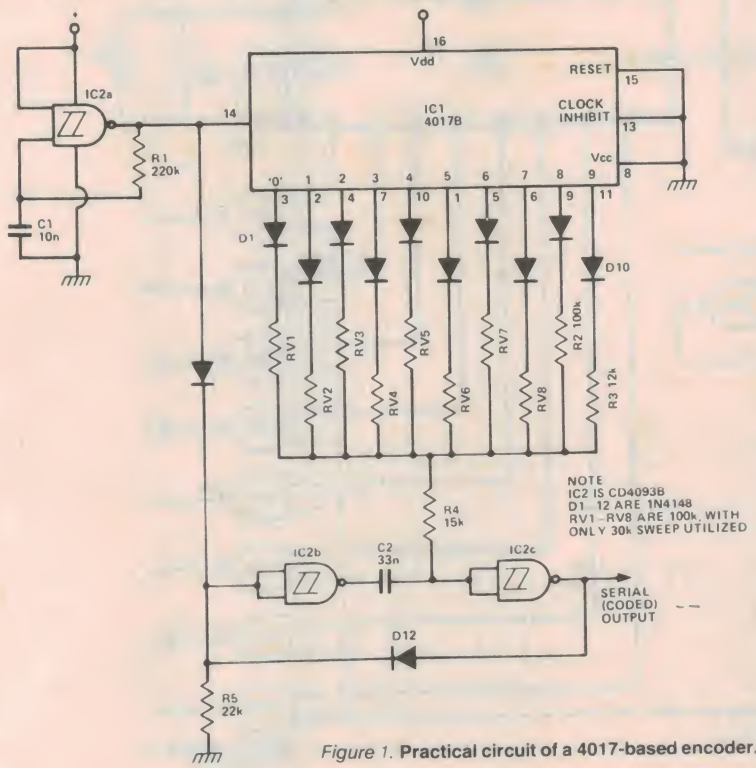

Figure 1. **Practical circuit of a 4017-based encoder.**

An 8-channel proportional control encoder

Figure 1 shows the practical circuit of a 4017-based 8-channel encoder for use in simultaneous control systems. IC2a is a 500 Hz (2 ms) astable multivibrator that simultaneously feeds clock signals ▶

Lab Notes

to the input of the 4017 and trigger signals to the input of the IC2b-IC2c monostable multivibrator. In any given clock cycle, the period of the monostable is determined by C2-R4 and by the resistance value in series with the relevant 'high' output of the 4017. In clock cycles '0' to '7' the pulse widths are determined by the settings of RV1 to RV8 respectively. In the '8' clock cycle the pulse has a width equal to the clock cycle period (2 ms), and in the '9' clock cycle the pulse is fixed at about 1 ms, thus giving a composite 3 ms sync pulse from the eighth and ninth cycles. The system is designed to give a fixed 20 ms frame width.

Note that, in conformance with normal practice, only one third (or less) of the sweep ranges of RV1 to RV8 are utilised. In practice, component values may have to be altered slightly to give precise ranges of coded output pulse widths.

An 8-channel proportional control decoder

Figure 2 shows the circuit of a decoder for use with the above system. The incoming 'coded' waveform is fed simultaneously to the clock terminal of the 4017 and to the trigger terminal (via C1-R1-D1) of the IC2c-IC2d monostable. IC2c of this monostable produces a negative-going pulse with a period slightly less than the 2 ms clock period (about 1.8 ms), and this negative pulse is ANDed with the positive clock signal by IC2a and IC2b to produce a reset output signal from the 3 ms input sync pulse, but not from the 'control' pulses, which all have periods significantly less than the 1.8 ms reference value.

Note that the value of R3 may have to be adjusted on test to set the correct reference period.

Outputs 1 to 8 of the 4017 are sequentially ANDed with the coded clock input signal once the counter has been reset by the sync pulse, so that each individual code pulse is routed to its own designated output terminal or channel. The individual outputs, which take the form of 0.5 ms to 1.5 ms pulses with repetition periods of 20 ms, can then be fed to suitable servos, etc, to convert the pulses into proportional mechanical movements.

An 8-channel simultaneous on/off encoder

Multi-channel simultaneous on/off coder/decoder systems are technically no easier to implement than full proportional systems. In fact they are often more difficult. Figure 3 shows a practical example of a simultaneous 8-channel on/off control encoder.

Here, astable multivibrator IC2a simultaneously feeds 500 Hz clock signals to the 4017, to the IC3a-IC3b 200 μs monostable multi, and to one input terminal of the IC2b-IC2c AND gate. The other input of the AND gate is sequentially taken from the '0' to '7' outputs of the 4017 via any of the PB0 to PB7 switches that are closed, and directly from the '9' output. The outputs of the AND gate and the 200 μs monostable, plus the direct '8' output of the 4017, are all ORed to produce the final serial coded output across R4.

The final output waveform comprises 200 μs pulses and 1 ms pulses to represent off and on switch states respectively, plus a 3 ms sync pulse spanning the eighth and ninth clock cycles.

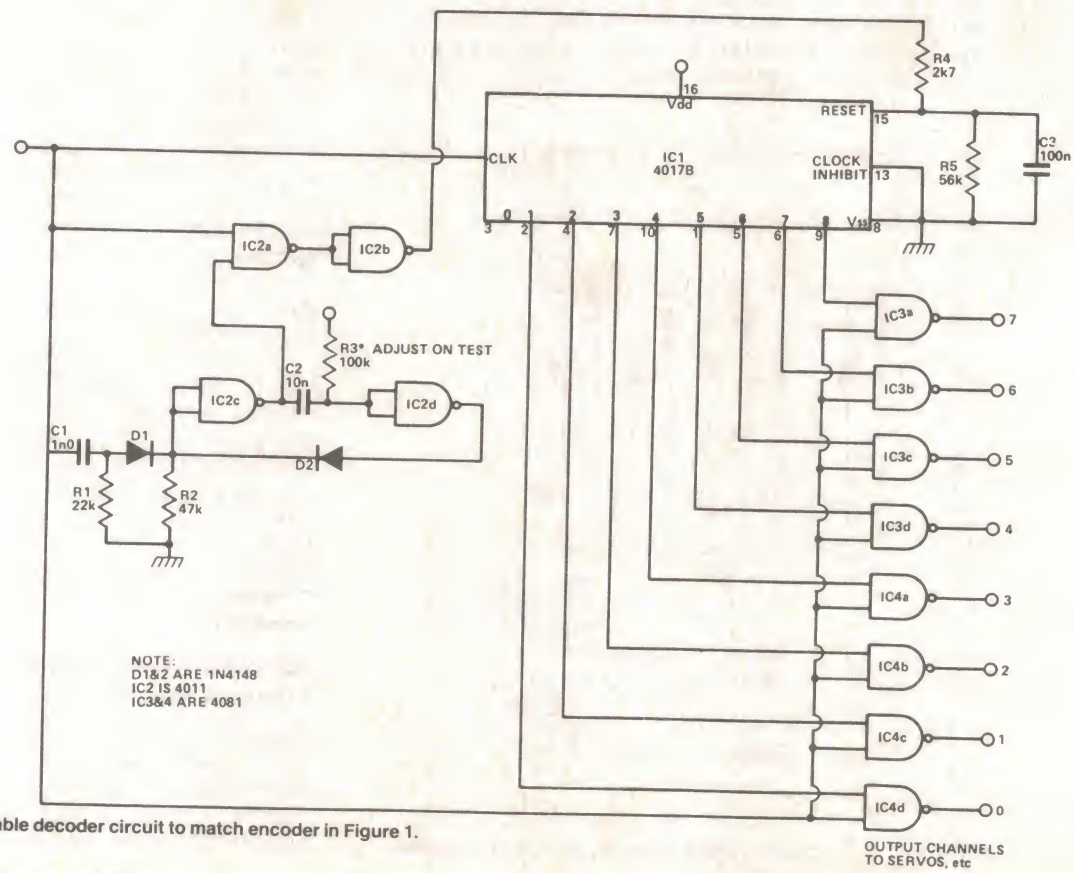

Figure 2. **Suitable decoder circuit to match encoder in Figure 1.**

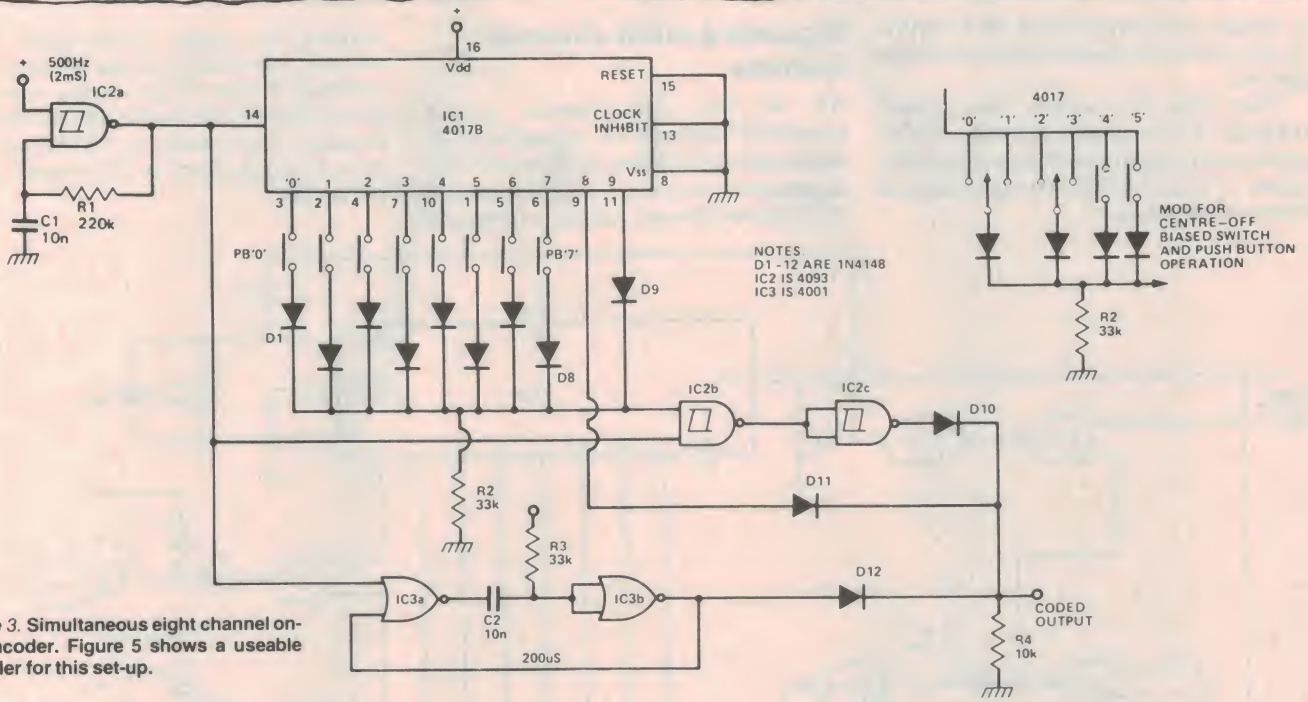

Figure 3. **Simultaneous eight channel on-off encoder. Figure 5 shows a useable decoder for this set-up.**

An 8-channel simultaneous on/off decoder

Figure 5 shows a decoder circuit that is suitable for use with the above encoder. Here, the IC3a-IC3b-IC2a-IC2b network detects the input sync pulse and then resets the counter, and the IC3c-IC3d-IC2c-IC2d network detects 'wide' (1 ms) or 'on' code pulses and then ANDs the selected output of the 4017 via the IC4-IC7 array to produce a high potential on the appropriate output channel. Note that the purpose of the D-R-C network in each output channel is to convert a detected 'wide' pulse into ▶

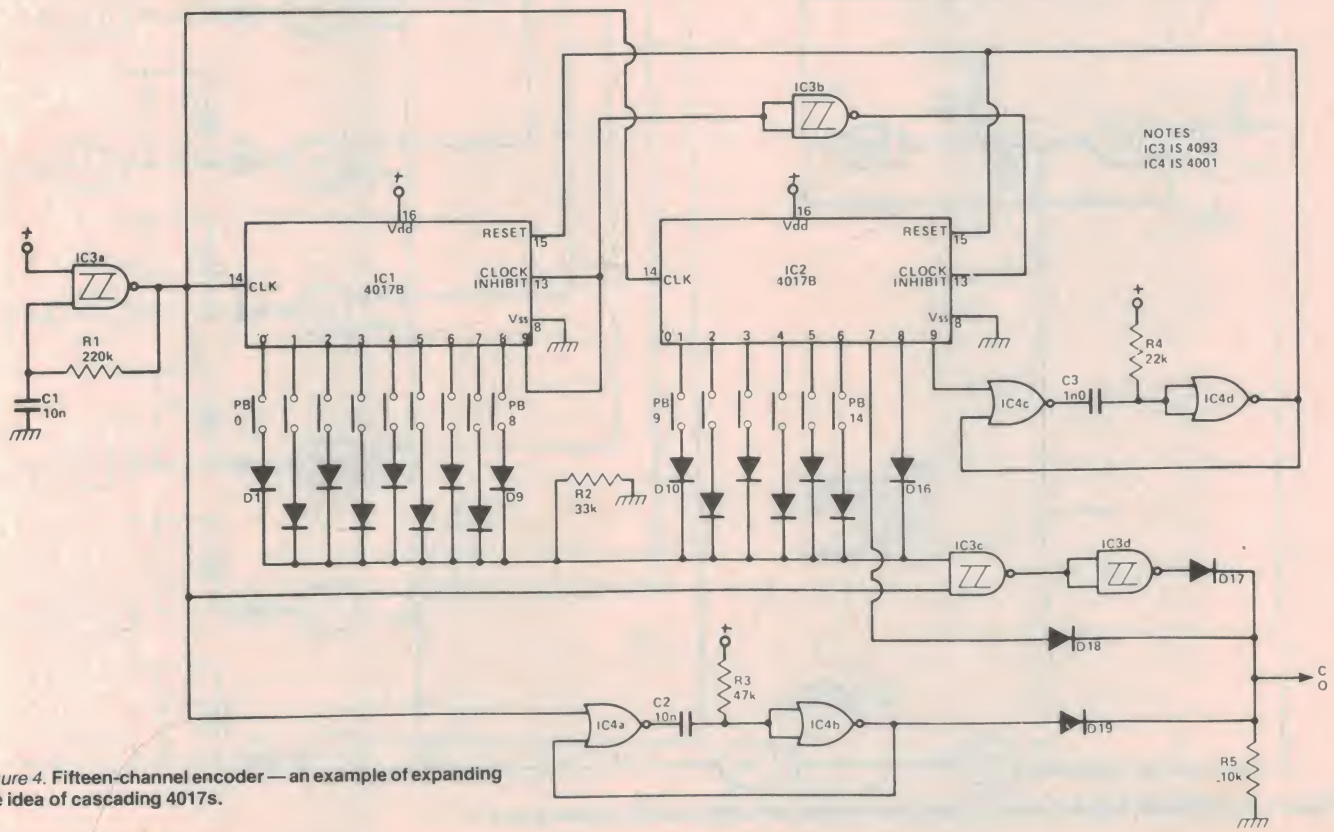

Figure 4. **Fifteen-channel encoder — an example of expanding the idea of cascading 4017s.**

Lab Notes

a steady dc voltage that will remain high (or low) for greater than one frame period.

Note that the steady (non-pulsed) outputs of the eight channels of this system can readily be binary decoded to make a total of 256 non-simultaneous channels available.

Expanded multi-channel systems

All of the coder/decoder circuits presented here can be expanded to incorporate any number of channels (with appropriate increases in frame periods and miscellaneous timing component values) by using multi-stage 4017 counter networks in place of the single counters shown. If you want more information on this circuit and its brother decoder, you'll have to wait until the circuit reappears in an ETI project some time later!

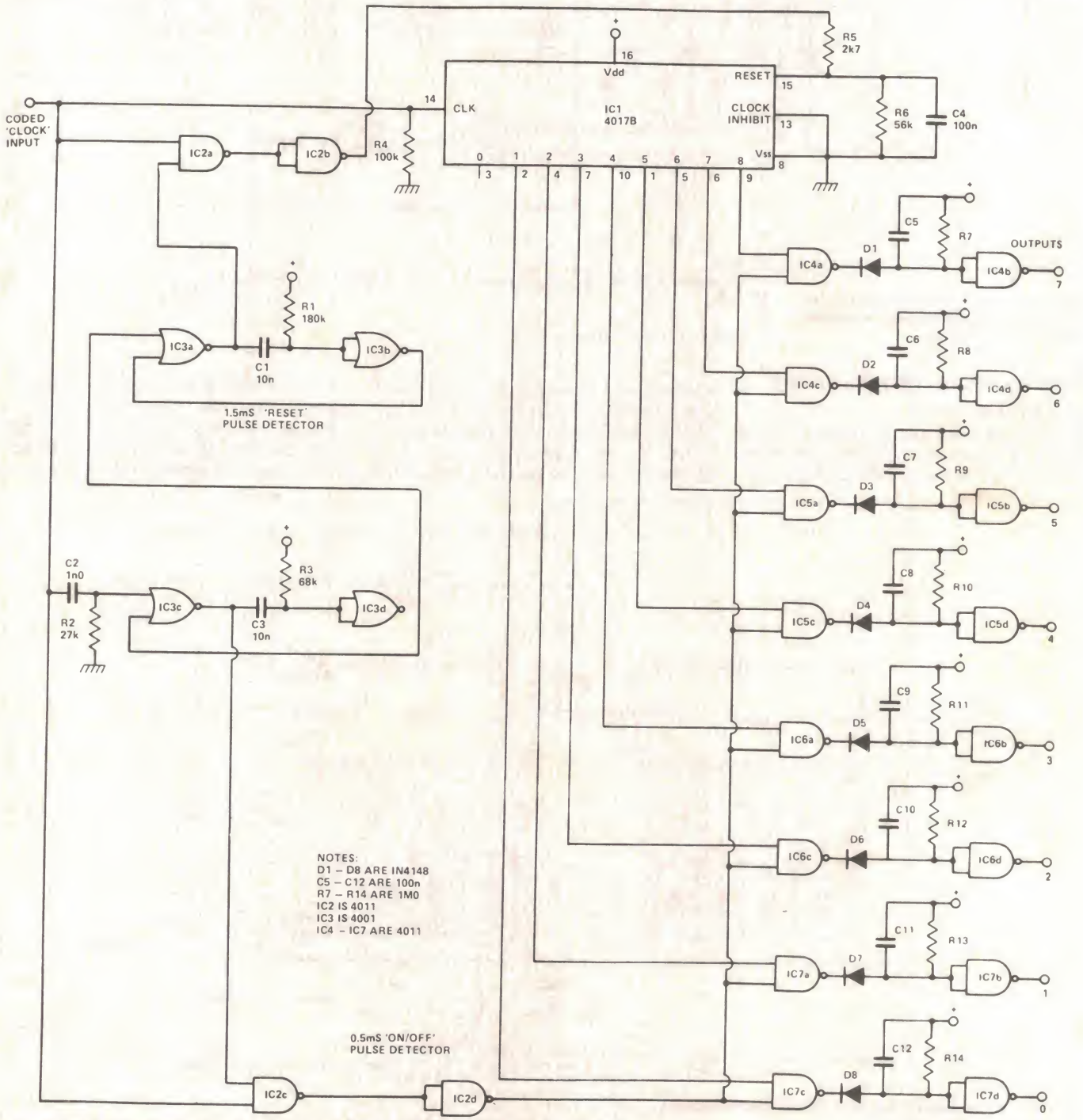

Figure 5. **Eight-channel decoder which will operate as a system with either encoder (Figures 3 or 4).**

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S4 ETI 482B Tone Control Board
S5 ETI 485 Graphic Equalizer
S6 ETI 480 50 watt Amplifier less H/S & bracket
S7 ETI 480 100 watt Amplifier less H/S & bracket
S8 ETI 480 Power Supply for above
S9 ETI 443 Expander Compressor
S10 ETI 444 Five watt stereo
S11 ETI 422B Booster Amplifier including metalwork
S12 ETI 438 Audio Level Meter
S13 ETI 440 25 watt Stereo Amplifier including metalwork
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S18 ETI 426 Rumble Filter
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G9 E.A. PM 138 20 watt Guitar Amplifier
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G16 ETI 454 Fuzz-Sustain less foot switch

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AT2 ETI 128 Audio Millivolt Meter
AT4 ETI 102 Audio Signal Generator
AT5 E.A. A.F. Tone Burst Generator
AT7 ETI 137 Audio Oscillator
AT8 ETI 138 Audio Power Meter

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PS2 ETI 581 Dual Power Supply (High Powered Version)
PS3 ETI 712 CB Power Supply
PS4 ETI 131 Power Supply
PS6 ETI 105 Laboratory Power Supply
PS7 ETI 111 I/C Power Supply
PS9 E.A. 1976 Regulated Power Supply
PS10 E.A. Dual 30-2 0-30V at 2A or 0-60V at 2A or Dual Pos and Neg 30V at 2A
PS11 E.A. C.B. Power Supply
PS12 ETI 142 Power Supply 0-30 V 0-15 A (fully protected)
PS13 ETI 472 Power Supply
PS14 E.A. Power Supply for Dream 6800
PS15 ETI 577 Dual 12V supply
PS16 E.A. Power Saver

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C2 ETI 632M Part 1 Memory Board V.D.U.*
C3 ETI 632P Part 1 Power Supply V.D.U.*
C4 ETI 632A Part 2 Control Logic V.D.U.*
C5 ETI 632B Part 2 Control Logic V.D.U.*
C6 ETI 632C Part 2 Character Generator V.D.U.*
C8 ETI 632 U.A.R.T. Board*
C9 ETI 631-2 Keyboard Encoder*
C10 ETI 631 A/Sch. Keyboard (less keyboard)*
C12 E.A. Educ-8 Computer
C13 E.A. Cassette-Tape Interface
C14 ETI 638 Eprom Programmer
C15 ETI 637 Cuts Cassette Interface
C16 ETI 651 Binary to Hex Number Converter
C17 ETI 730 Getting Going On Radio Tele Type
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C19 ETI 731 R.T.T.Y. Modulator
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TE3 ETI 533C Digital Display
TE4 ETI 129 R.F. Signal Generator
TE5 ETI 130 Temperature Meter
TE6 ETI 706 Marker Generator
TE8 ETI 122 Logic Tester
TE9 ETI 124 Tone Burst Generator
TE10 ETI 123 C Mos Tester
TE11 ETI 116 Impedance Meter
TE12 ETI 533 Digital Display
TE13 ETI 117 Digital Voltmeter 1975 Display
TE14 ETI 117 Digital Voltmeter 1976 Display
TE15 ETI 704 Cross Hatch Dot Generator
TE16 ETI 120 Logic Probe
TE17 ETI 121 Logic Pulser
TE18 ETI 118 Digital Frequency Meter 1975 Display
TE19 ETI 118 Digital Frequency Meter 1976 Display
TE33 E.A. Simple Function Generator
TE34 ETI 487 Real Time Audio Analyser
TE35 ETI 483 Sound Level Meter
TE36 ETI 489 Real Time Audio Analyser
TE37 ETI 717 Cross Hatch Generator
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TE41 E.A. Function Generator
TE42 E.A. Transistor Tester incl. BiPolar & F.E.T.S.
TE43 ETI 591 Up Down Pre-setable Counter
TE44 ETI 550 Digital Dial (less case) includes ETI 591
TE45 ETI 144 Expanded Scale R.M.S. Voltmeter
TE46 ETI 148 Versatile Logic Probe
TE47 ETI 724 Microwave Oven Leak Detector
TE48 ETI 150 Simple Analog Frequency Meter
TE49 ETI 151 Linear Scale Ohm Meter
TE50 ETI 152 Linear Scale Capacitance Meter
TE51 E.A. Digital Capacitance Meter
TE52 ETI 589 Digital Temp. Meter
TE53 E.A. T.V. C.R.O. Adaptor less Power Pack
TE54 E.A. XTAL Locked Pattern Generator
TE55 E.A. Decade Resistance Sub Box
TE56 E.A. Capacitance Sub Box
TE57 E.A. Decade Capacitance Sub Box
TE58 E.A. Tantalum Capacitance Sub Box
TE59 ETI 140 1 GHZ Frequency Meter/Timer
TE60 ETI 572 PH Meter
TE61 ETI 135 Panel Meter

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WS3 ETI 528 Home Burglar Alarm
WS4 ETI 702 Radar Intruder Alarm
WS7 ETI 313 Car Alarm
WS12 ETI 582 House Alarm
WS14 E.A. 1976 Car Alarm
WS15 E.A. 10 Ghz Radar Alarm
WS16 E.A. Light Beam Relay
WS17 ETI 247 Soil Moisture Indicator

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MT2 E.A. 1974 Model Train Control
MT6 E.A. 1978 Train Control

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A7 ETI 301 Vari-Wiper
A14 E.A. Dwell Meter
A15 E.A. Variwiper
A16 E.A. Tacho for Tune-ups
A17 E.A. Ignition Analyser and Tachometer
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A25 ETI 555 Light Activated Tacho
A26 ETI 320 Battery Condition Indicator
A27 E.A. Transistor Assisted Ignition
A28 ETI 324 Twin Range Tacho less case
A29 ETI 328 LED Oil Temp Meter less V.D.O. probe

PHOTOGRAPHIC
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PH3 ETI 514B Sound Light Flash Trigger
PH4 ETI 532 Photo Timer
PH7 ETI 513 Tape Slide Synchronizer
PH10 ETI 540 Universal Timer
PH12 E.A. Sync-a-Slide
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M6 ETI 544 Heart Rate Monitor
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M10 ETI 539 Touch Switch
M14 ETI 701 Masthead Amplifier
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M30 ETI 551 Light Chaser 3 channel 1000 watt/ch
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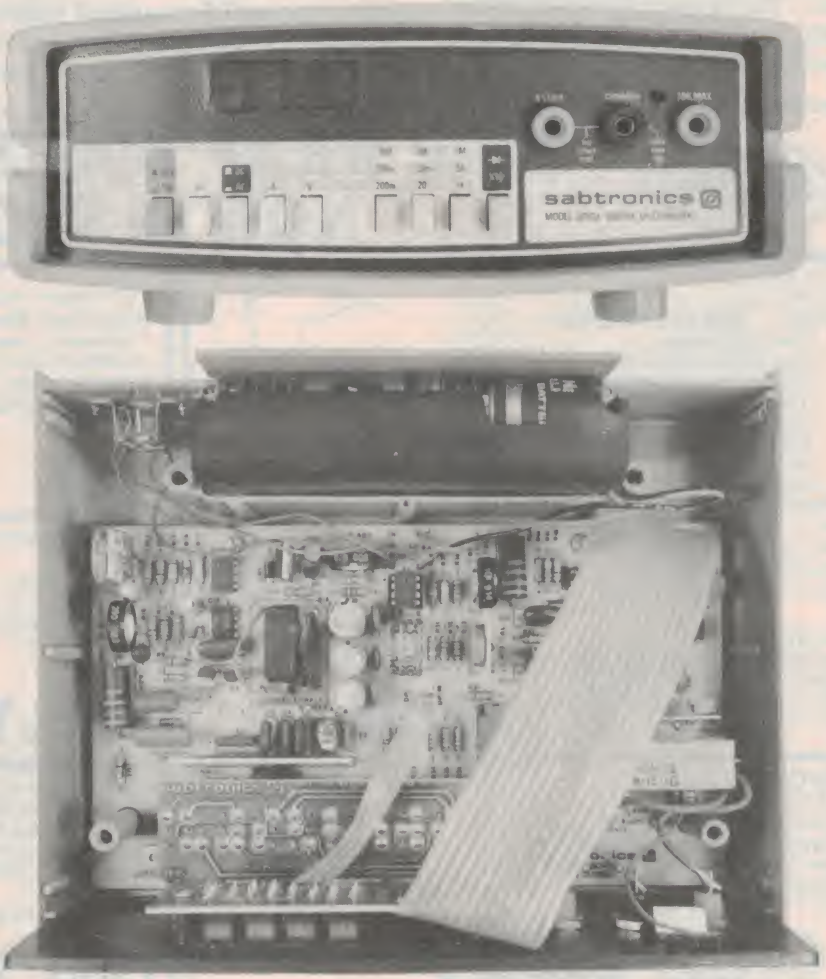
Building a bench DMM

The variety of 'bench' digital multimeters available is quite wide and making a choice depends on many factors, price being a prime consideration. Can you get what you want in a do-it-yourself kit and save money?



THE SABTRONICS RANGE of bench instruments is available in both kit and built-up form in Australia, distributed by the Sydney-based company, Christie Rand. We took the opportunity recently of building one of their kits — the Model 2010A bench digital multimeter. This features a 3½-digit LED display and dc accuracy is quoted as 0.1%. It has five dc and ac voltage ranges from 260 mV to 1000 volts, six dc and ac current ranges from 200 μA to 10 A, resistance from 200 ohms to 20 M and a diode test function at 1 mA, 10 μA and 0.1 μA. Accuracy on ac ranges is given as 0.5%. The kit is priced at $138 (inc. tax). It is intended for battery operation.

The kit comes well-packed and includes individually packed resistors, capacitors, semiconductors and calibration components (and sheet), plus all necessary hardware. Assembly and operator's manuals are included. We found nothing missing, and most parts appeared to be of high quality.

The kit was quite easy to assemble, the instructions being clear and easy to follow. It took about four to five hours. One capacitor turned out to be the wrong value.

A soldering iron with a small tip is essential. Flux stripping of the pc boards was necessary, but needs to be done with care to prevent the solvent affecting plastic parts.

When it came to calibration, we ran into difficulties. Two procedures are given; we found procedure #1 easy and accurate, and it's enough to get the unit up and going, *except* the method for ac where the parts were not supplied. The peak detect method we think is *dangerous* as it requires measurement on the mains. The book gives a warning, however. The high frequency compensation procedure is a guess.

Procedure #2 requires access to test equipment but is more detailed and results in greater accuracy. We checked it against our Fluke 8600A bench DMM and the 2010A came within specification.

When completed the unit looks attractive, is functional and easy to use. The case has a wire tilt stand which can be used at the front or the rear. Although battery powered, it could be supplied from a plug pack. Nicads may be used as the voltage regulator on board is adjustable. The ranges provided are useful, particularly the ac current and the diode test. The x10 switch is also useful! The decimal point sensibly shifts with range change.

So much for the 'fors'. Now the 'againsts'. The test leads do not have finger guards, in common with every other instrument we've handled in recent years. The LED display presents a high current drain so the four 'C' cells powering the unit do not last too long. The battery compartment and clip fitted badly on our unit. During construction we found that some identification numbers on the pc board did not agree with the parts list or assembly instructions, but it was obvious where things went. The holes for the power resistor leads were not drilled large enough. The ribbon cable supplied to provide interconnection between boards had single-strand wire and care is necessary to prevent fracture. One capacitor was the wrong value (C7 in ours) and caused problems in the ac calibration procedure.

We would recommend this kit only for the constructor with some experience. If you're prepared to go to the minor trouble of constructing it yourself, you can obtain quite a useful instrument that will serve your measurement needs for many years, and at a very attractive price. We felt several aspects could be improved upon, but overall the Sabtronics 2010A is well worth close consideration if you're after a bench DMM.

Further details can be obtained from Christie Rand Pty Ltd, P.O. Box 48, Epping NSW 2121. (02)477-5494.

Simon Campbell
Roger Harrison

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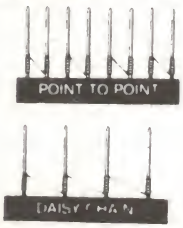

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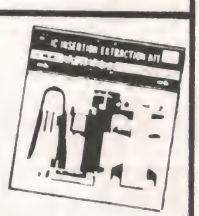

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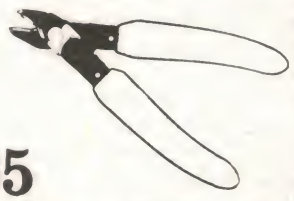

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Ideas for Experimenters

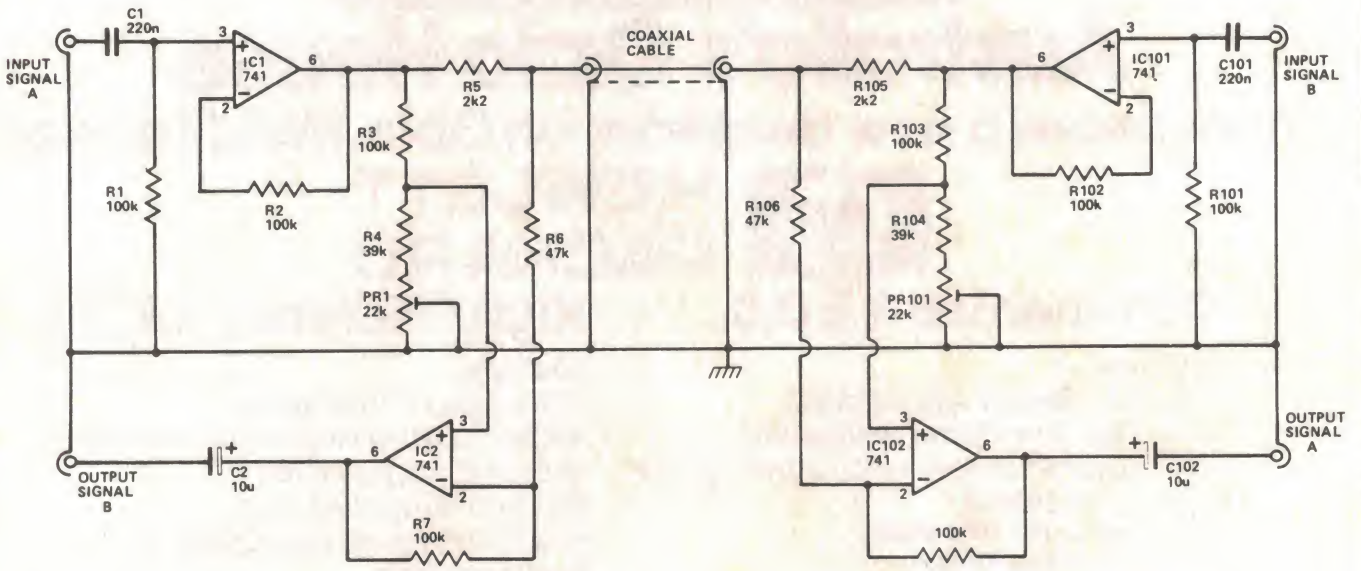
These pages are intended primarily as a source of ideas. As far as reasonably possible all material has been checked for feasibility, component availability etc, but the circuits have not necessarily been built and tested in our laboratory. Because of the nature of the information in this section we cannot enter into any correspondence about any of the circuits, nor can we produce constructional details.

Bidirectional audio link

This simple circuit arrangement from **T. Hopkins of Stockport, UK**, enables audio signals to be sent along a single piece of coaxial cable in both directions simultaneously. The input signals are buffered by IC1, IC101 and fed to the cable by resistors R5, R105. IC2, IC102 subtract the signals on the cable from the output of the buffer amplifier; the difference is the signal put onto the cable at the other end. The net result is that signals inserted at one end appear only at the other end.

The audio signals should be between 100 mV and 3 V (RMS). Potentiometers PR1, PR101 set the rejection of the unwanted signal; these should be of good quality and preferably multiturn presets. A rejection of 50-55 dB can be obtained.

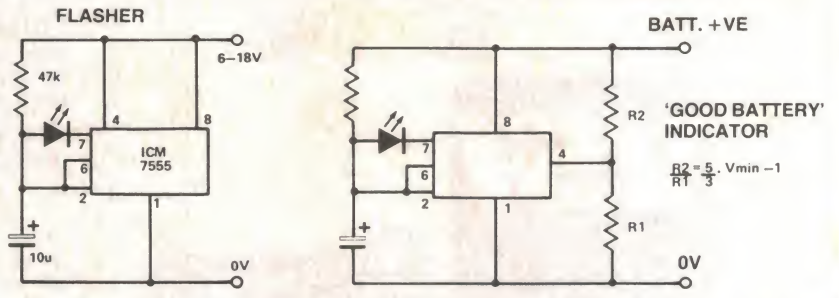
The prototypes were used in an audio system where the control unit was remote from the signal source and the power amplifiers and speakers. Other possible uses include intercom and talkback systems. If this technique is tried at higher frequencies, resistors R5, R105 should be adjusted to match the characteristic impedance of the coaxial cable used. A similar system has been successfully used for digital signals.



Micropower LED flasher

This circuit will brightly flash an LED, yet draws a supply current of only 150 μA. In a normal 555 astable, the timing capacitor is discharged straight to ground. Here, the charge is made use of by discharging it through the LED. A suggested use is for an on-off indicator in a battery-powered circuit.

With a slight modification the circuit can be used as a good battery indicator. A potential divider is connected to pin 4 (reset) from the supply rail of the circuit whose battery is being monitored, so that when the supply drops below a predetermined voltage, then the voltage on pin 4 drops below 0.7 V. Thus the LED will only flash if the supply is higher than the predetermined voltage. Keep the value of the resistors high to reduce current consumption (e.g: 1M for R1).



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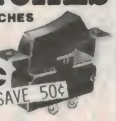

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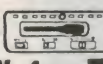

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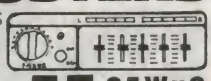

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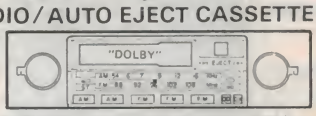

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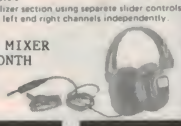

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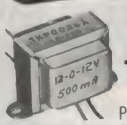

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BONUS: BUY ANY 9, GET 1x5" FREE!

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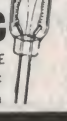
28V 40mA

50c EA



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LA250

LA270

SPECIFICATIONS

LA230
Power Output:
(typical both channels driven into 8 ohms)
30 watts RMS/channel

LA250
Power Output:
(at 8 ohms)
50 watts RMS/channel

LA270
Power Output:
(at 8 ohms)
70 watts RMS/channel

LA230	~~$205.00~~	$165.00
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LA270	~~$349.00~~	$285.00

Whilst Stocks Last

Now that you can see we've got a great Amplifier here're the Speakers

LINEAR

L33-75

SPECIFICATIONS

L22-30
Response:
60Hz – 18KHz ± 5db
Power:
30 watts RMS

L33-50
Response:
50Hz – 18KHz ± 4db
Power:
50 watts RMS

L33-75
Response:
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Power:
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L22-33	~~$199.00 pr~~	$170.00 pr
Limited stock on this		
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SAVE $100.00		
L33-75	~~$499.00 pr~~	$379.00 pr
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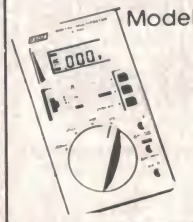

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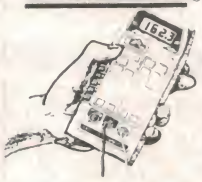

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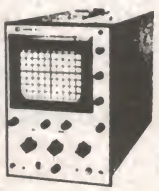
How's this for VALUE!! **GW** GOOD WILL



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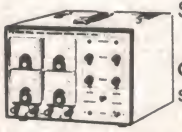
GAG808 Audio Generator $189.00

GVT706 Millivolt Meter $169.00



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sinclair ZX80

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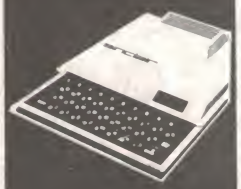

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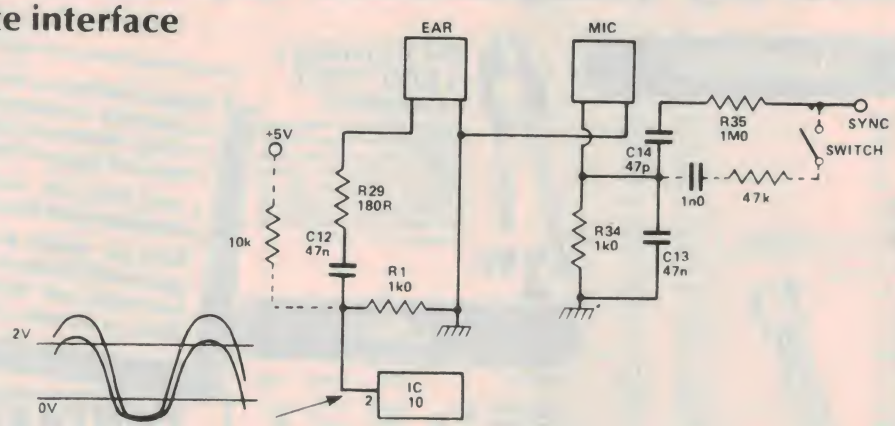
Ideas for Experimenters

Improving the ZX80 cassette interface

J.C. Corall

THE SIGNAL OUTPUT from the computer to the cassette recorder is usually about 1 or 2 V RMS while SAVEing, which is about the right level for the microphone input of many cassette recorders. Unfortunately, the small size of this signal means there is always a danger from ambient noise. With the additions to the circuit shown, closing the switch raises the output signal to about 30 mV, which makes it compatible with the "Auxiliary" socket on cassette recorders. A ZX80 modified in this way has also been found to give satisfactory recordings when connected to the DIN socket of a music centre. Playback is made through the headphone socket to the computer.

When loading a program, the signal from the cassette recorder is fed to an LS TTL buffer, which requires at least 2 V on its input to register a logic 1. A cassette recorder that runs from 6 V, for example, can be hard pushed to supply this sort of signal without severe distortion.



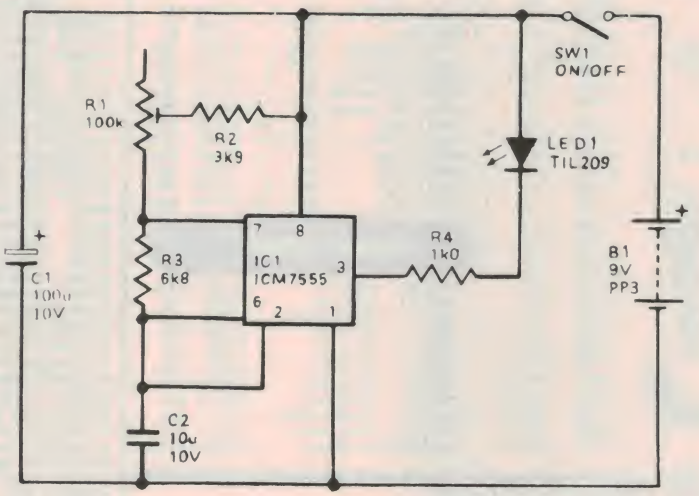
However, a 10k resistor added as shown forms a potential divider with R1, and adds 0.5 V dc shift to the signal. This has been found to allow reliable program loading over a range of cassette volume control settings.

Simple photographic timer

ALTHOUGH this timing device may seem to be rather unsophisticated, it is a handy little gadget for timing darkroom exposures, or time exposures, or time exposures made on a camera with the shutter set to the 'B' position. The unit simply flashes a LED indicator briefly at one-second intervals. If, for example, one wishes to make a ten-second time exposure, then the shutter is opened during any convenient flash produced by the unit, and then closed after a further ten flashes have been produced. Adequate accuracy for normal requirements can be obtained in this way.

The circuit is based on the CMOS version of the well known 555 timer device. The CMOS version has the advantage of having a current consumption which is only about one hundredth of that taken by the conventional version, and this is obviously beneficial in a battery-powered piece of equipment such as this one. The average current consumption of the unit is actually less than 1 mA, giving an extremely long battery life.

The CMOS version of the 555 operates in the same basic manner as the ordinary version, with timing capacitor C2 first charging up to ⅔ V+ by way of the timing resistors — R1, R2, R3. The device is then triggered into the discharge mode, resulting in C2 being discharged through R4 to a potential of ⅓ V+, whereupon the circuit reverts to its original state with C2 charging up once again. Continuous oscillation thus results. The frequency of operation is adjusted to 1 Hz by adjusting R1, and in practice this is adjusted by trial and error to obtain (say) 60 flashes in a one-minute period. Longer calibration periods can be used if better accuracy is required.



The output of IC1 assumes the high state while C2 is charging, and the low state while it is discharging. As C2 charges via R1, R2 and R3, but only discharges through R4, the discharge time is therefore much shorter than the charge time. By connecting LED indicator D1 and its current limiting resistor R4 between the output of the IC1 and the positive supply, the required brief flashes are thus obtained. ●

ERRATA

A rather obvious, but potentially dangerous error occurred in the circuit on the top left of page 60 ('Power Monitor') in the March issue. It shows the mains active input connected to the earth at the output. The mains active input should instead go to the fuse. Correct your copy now. Correction slips were inserted in the majority of copies distributed.

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AC127	Z-1062	95c
AC128	Z-1064	95c
AC187	Z-1080	80c
AC188	Z-1082	95c
AD161	Z-1110	$1.75
AD162	Z-1112	$1.75
BC109C (BC549C,BC209C)	Z-1329	34c
BC159 (BC179,BC214,BC559)	Z-1359	17c
BC639,BC640	Z-1388	45c
BC640	Z-1389	45c
BCY71	Z-1241	95c
BD139	Z-1443	55c
BD140	Z-1444	55c
BD682	Z-1460	$1.45
BD681	Z-1462	$1.26
BF115	Z-1560	75c
BF173	Z-1590	89c
BF180	Z-1602	73c
BF184	Z-1604	$1.00
CL33 NPN disp driver	Z-1750	$1.00
CL34 PNP disp driver	Z-1752	90c
D13T1 (2N6027) PUT	Z-1780	59c
DS2646 UJT	Z-1786	95c
FPT100 (photo trans)	Z-1950	$1.38
MEL12 (photo darlington)	Z-1952	95c
MJ2955	Z-1800	$1.50
MPF102	Z-1832	59c
MPF105 (2N5459)	Z-1838	58c
MPF106 (2N5484)	Z-1840	58c
MPF131 (MPF121)	Z-1848	$1.20
OC26 (AD149)	Z-1930	$2.75
OC44	Z-1932	95c
OC71	Z-1941	75c
TIP31B	Z-2020	79c
TIP32B	Z-2024	79c
TIP2955 (MJE2955)	Z-2005	$1.25
TIP3055(MJE3055)	Z-2008	$1.25
TT800(2N4030)	Z-2064	89c
TT801(2N3019)	Z-2068	89c
2N2053	Z-2130	53c
2N3055	Z-2145	83c
2N3055 (Motorola)	Z-1804	$1.50
PN3563	Z-2180	30c
BC337	Z-2190	23c
BC328	Z-2242	17c
2N4360	Z-2246	22c
PN3642	Z-2250	45c
BC338	Z-2252	30c
PN3645	Z-2256	25c
PN4250	Z-2320	48c
PN4258	Z-2326	38c
2N4342	Z-1833	$1.18
2N5484	Z-2340	58c
2N5590	Z-2390	$6.50
2N5591	Z-2391	$12.95
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BUX80	Z-2150	$7.50
MJI5003	Z-1808	$5.00
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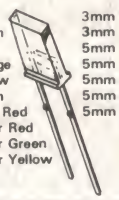
LEDS

Type No	Size	Cat No	Price
Small Red	3mm	Z-4010	20c
Small Green	3mm	Z-4020	28c
Large Red	5mm	Z-4030	16c
Large Orange	5mm	Z-4036	55c
Large Yellow	5mm	Z-4034	34c
Large Green	5mm	Z-4032	28c
Large clear Red	5mm	Z-4038	55c
Rectangular Red		Z-4040	40c
Rectangular Green		Z-4042	40c
Rectangular Yellow		Z-4044	40c
Infra Red		Z-3235	$1.50



RECTIFIERS

Type No	PIV	A	Cat No	Price
1N4002 (EM401)	100	1	Z-3202	6c
1N4004	400	1	Z-3204	8c
1N4007 (EM410)	1000	1	Z-3207	14c
1N5408 (MR510)	1000	3	Z-3228	43c
1N5404 (1N5624)	400	3	Z-3222	43c
MR110 (S0-10 stud)	100	10	Z-3240	$1.45
MR410 (S0-10 stud)	400	10	Z-3244	$1.95
BYX21L/200	200	25	Z-3260	$1.95
BYX21L/200R	200 (r)	25	Z-3262	$1.90
WO-2 bridge	200	1.5	Z-3300	$1.90
WO-4 bridge	400	1.5	Z-3304	70c
PA60 bridge	600	8	Z-3326	$5.50
PB40 bridge	400	25	Z-3334	$5.50

SIGNAL DIODES

Type No	Type	Cat No	Price
DSOA91	Germ G/P	Z-3042	12c
OA47	Gold Bonded	Z-3232	38c
OA90	Germ G/P	Z-3030	18c
OA91	Germ G/P	Z-3040	18c
OA95	Germ G/P	Z-3050	18c
BB119	Silicon G/P	Z-3060	34c
BA102	Sil Varicap	Z-3070	43c
OA202	Sil small signal	Z-3100	34c
1N4148	Hi Sp switch	Z-3120	5c
5082-2800	Hot carrier	Z-3230	$2.88

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DS557 (Z-1340) DS558 (Z-1348) ALL 17 cents each!!!

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(Introduced since our last catalogue).

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BF460	Transistor	Z-1636	$1.20
BPW50	PhotoDiode	Z-1956	$3.50
2N5245	N Channel JFET	Z-2335	90c
–	4 digit L/C display	Z-4175	$8.95
MC3021	Opto Triac Driver	Z-4516	$2.75
-	60 deg. solar cell	Z-4835	$2.95
74LS05	Hex Inverter	Z-4905	40c
74LS32	Quad 2 input NOR	Z-4932	35c
74LS86	Quad 2input OR	Z-4986	45c
74109	Dual J/K flip flop	Z-5252	50c
74157	Multiplexer	Z-5267	85c
74LS139	Multiplexer	Z-5285	90c
74LS165	Par load 8 bit s/r	Z-5288	$1.65
74LS1746	bit D flip-flop	Z-5290	$1.00
74LS367	Hex driver/3 st o/p	Z-5292	75c
74LS373	Dual D flip flop	Z-5295	$1.95
81LS95	(97) tri-st. oct div.	Z-5300	$1.80
4040	Bcd/dec decoder	Z-5640	$1.70
4046	phase-locked-loop	Z-5646	$1.95
4069	Inverter Circ.	Z-5669	45c
40938	Quad 2 in Schmitt	Z-5693	65c
40194	4 bit bi direct s/r	Z-5694	$3.50
7216B	freq/period counter	Z-5747	$29.95
MM5369	(EYRN) 60 Hz div	Z-5782	$3.50
CA3080	Op amp	Z-6024	$2.45
TL071cp	Fet inp op amp	Z-6030	95c
TL074cp	quad fet op amp	Z-6034	$2.75
LM334N	Quad comparator	9Z-6039	70c
LM311	Voltage compar.	Z-6048	70c
LM394C	Dual matched pre.	Z-6083	$4.50
NE5534	Low noise preamp	Z-6090	$4.25
ICL7106	3.5 digit driver	Z-6300	$9.50
LM317T/KC	Adj pos v/reg	Z-6541	$1.95
LM334	Temp Sensor	Z-6810	$1.95
MM5865	Timer	Z-6816	$9.75
XR2206	Synthesiser IC	Z-6820	$5.95
79101	Melody IC	Z-6822	$6.25
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8V2 (1N4738)	Z-3535	9V1 (1N4739)	Z-3537
10V (1N4740)	Z-3539	11V (1N4741)	Z-3541
12V (1N4742)	Z-3543	13V (1N4743)	Z-3545
15V (1N4744)	Z-3547	16V (1N4745)	Z-3549
18V (1N4746)	Z-3551	20V (1N4747)	Z-3553
22V (1N4748)	Z-3555	24V (1N4749)	Z-3557
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33V (1N4752)	Z-3563		

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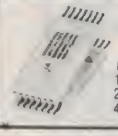

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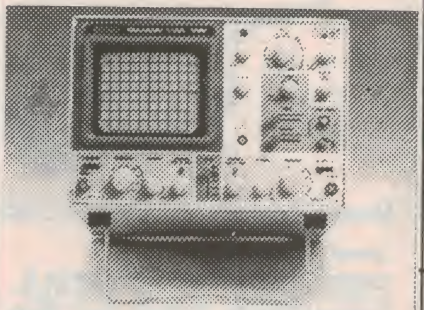

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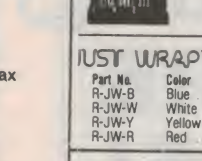

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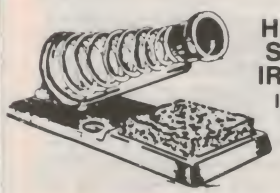

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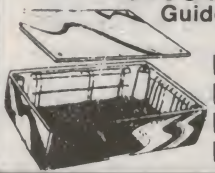

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Shoparound

THIS PAGE is to assist readers in the continual search for components, kits and printed circuit boards for ETI projects. If you are looking for a particular component or project — check with our advertisers if it is not mentioned here.

ETI-332 stethoscope

So far as components and component availability are concerned, this project is straightforward. The K&W C642 case is quite inexpensive and stocked by many retailers. We used collet knobs for the pot shafts and both C&K and Associated Controls distribute a range, which you'll also find widely stocked.

For the probes, crystal earpieces or mic inserts make excellent microphones. Crystal earpieces are convenient and cheap, and we attached a length of aluminium tube to the earplug part of a crystal earpiece for a probe. Again, crystal earpieces and mic inserts are widely stocked. The same goes for headphones. Only an inexpensive pair of 'phones need be bought.

ETI-1503 battery charger

The only 'stock' power transformer we could locate to suit this project was the Dick Smith model M-2000. This has a secondary rated to provide 18 V at 6 A load but can deliver well over twice that current for short periods, with some drop in output voltage — but that has been taken into account in this design. The relay used was a DEC type MC2U with contacts rated at 10 A. This too is stocked by Dick Smith, catalogue No. S-7200. The Fujitsu type FRL264/D012/02CK is also suitable. This is distributed by IRH Components and available through a number of suppliers. It is the same relay we used in the ETI-567 core-balance relay back in the April issue.

The Arcol HS25 0R22 resistor (R1 in the circuit) we obtained from Everest Electronics, 61 Compass Drive, Seaford S.A. 5169. If you intend using the light globe substitute circuit you will need another Arcol resistor, an R047 HS25, obtainable from the same source.

For the meter, we used a TD-66 centre-zero type, 1 mA fsd. These are supplied by University Graham Instruments, who can supply suitable scales for this project as well.

The whole project was housed in a K&W case, type C1066. These are manufactured and distributed by Ballarat Electronic Supplies, 5 Ripon St, Ballarat Vic. 3350. (See June issue Shoparound, p.79). Many retailers are stocking cases from the K&W range and readers should experience little difficulty in obtaining a case.

ETI-607 sound effects

As Murphy's law would have it, the SN76488 IC which this series of projects hinges upon provided some difficulties for us. However, we must acknowledge the efforts of staff at VSI Electronics and Texas Instruments Australia in arranging a source of supply so that the chips would be available when this issue went on sale. Thanks, chaps.

The SN76488 comes in two packages — the A package (standard size, 28 pins) and the NF package (small size, 28 pins). The pinout for each is the same but we had to design a pc board to suit each package without varying the location of the other components. Make sure you buy a pc board to suit the package of the device you purchase. The board should be marked 'A pack' or 'nf pack' accordingly.

VSI Electronics will be stocking the SN76488 but we understand many suppliers will be carrying kits, so contact your favourite/nearest kit supplier.

We also note that Tandy stores stock the A pack SN76488 in a bubble pack with data sheet, catalogue number 276-1766, for $9.95.

Suitable speakers for these projects are a common item.

Specials

Every enthusiast loves a bargain! Jaycar in Sydney are making an extraordinary offer for the months of August and September. In constructing a project, you will always need resistors, usually ¼ W, 5% types. If you are buying $15 worth of goods from them, then the resistors (¼ W, 5%) will be free, with a limit of 30 per order. That's roughly a 10% discount. It's available to all personal and mail order customers and, if popular (if? . . . Ed.), will become a permanent service, says proprietor Gary Johnston.

LETTERS

Dear Sir,

I note your "new direction" editorial — an excellent objective.

As a subscriber to this journal since its inception, and also to many other technical journals for many years, I wish to make some suggestions, hopefully helpful.

1. Indexing. There is a wealth of technical information in there but with over ten years filed on my shelves how do I refer back to it? I suggest:

(a) Page 3 index clearly set out like your new Quick Index but more complete so that one can more surely and quickly identify what the project or article is about.

(b) "Ideas for Experimenters" (valuable) should be listed in the index, ditto "Shoparound".

(c) An annual index in December issue is a must. This should be under sub-headings, and on a recognised position preferably the last pages.

(d) From time to time a comprehensive index going back over say five years should be published.

(e) I do not appreciate your messy index on pages 4 & 5.

(f) The "Kits for Projects" index is valuable and would be even better if after each was added the page number e.g: Electronic Mouse Trap (Aug 82 p.27).

As I subscribe to at least ten Australian and overseas electronic monthly magazines I can assure you that your magazine has a host of valuable articles, but is one of the poorest for referencing for the reasons I have indicated.

I would also be interested if you arranged to supply annual binders — they would have to be thicker than the usual because of your thicker magazines.

I trust my comments are of use, and hopefully achieve some action.

Bruce R. Mann
VK3BM
Swan Hill, Vic.

Many thanks for your recent letter concerning our new directions and your comments on indexing and referencing.

You will be pleased to note in our April issue a ten year project index. Also in the April issue, as we do each year now, you will find last year's index which includes a complete index of "Ideas for Experimenters". The December '74 issue contains indexes for Volumes 1, 2, 3 and 4 (1971 to 1974 inclusive), December '75 contains the Volume 5 index, January '77 the Vol. 6 index, April '79 Vol's. 7 and 8 indexes. The indexes appear in April now to give us time to compile and correct the previous year's index and collection of errata (e.g: errata for the November and December issues would appear in the following year's January to March issues and must be included in the index — hence the index does not appear in the December issue.).

Regarding our monthly indexes (or ('contents'), I am sorry you do not like our two page index on pages four and five. However, readers seem to be divided on this issue — as are staff, I might add. We are currently researching a different way to present the contents.

For space reasons we are no longer regularly publishing the "Kits for Projects" page. When we first published it many readers quite clearly found it valuable and used it but that seems to be no longer the case.

Whilst we have done a ten year project index, appearing in the April issue as I said before, we are looking at compiling a ten-year index of articles in other categories. As you would appreciate this is an enormous undertaking.

With regard to binders, these can be supplied at $7.50 each and are advertised on our 'credits and services' page each month, generally located immediately before the Dregs page.

Many thanks for your comments and suggestions once again. We appreciate letters like yours.

Roger Harrison,
Editor.

Dear Sir,

I feel I must comment on the letter submitted by Mr. G. Tucker re Permostat in the ETI June '81 issue.

I am afraid I disagree with all that he says. I first saw an ad for Permostat in an English publication, Hi-Fi for Pleasure. I kept a sharp lookout and as soon as the first batch arrived in Australia I bought a kit.

Before this my antistatic defences were conducting felt mats plus a Decca carbon fibre earthed conductor on an arm which tracked the record. In spite of this the record gathered dust, and often the carbon fibres were loaded with it.

I admit my first few attempts with Permostat were a mixed blessing (my fault). I put too much on and didn't buff dry enough. Result: record sticks in plastic cover and when viewed in the light shows a slight patina on the surface. Nevertheless results were outstanding.

I have a collection of over 500 records, about 250 classical and the rest very easy listening and jazz. Although not really expensive per record, it is expensive to Permostat them all when you have hundreds of records, so over the last 18 months or so I have nearly done all the classicals. If I live long enough I'll do the lot.

The proper way to use the stuff is to spray the record very very lightly from at least one foot away. Then get the buffing pad into action very quickly, within seconds, buffing the whole side four or five times. Then you're in business.

I have dispensed with my Decca fibre brushes now because they don't pick up any dust as there is none on the records. The stylus doesn't have to be shampoo'd after each side and life is a whole lot easier.

In case you think I am a wide-eyed wonder, at age 73 I can recall the then manager of Kriesler Radio in about 1959 listening to one of the few stereo home-made outfits in Australia. Kriesler brought out their first stereogram three months later. My present set-up is nice, though only a quarter of the cost of Mr. Tucker's; but it's built to suit my tastes. Speakers I designed myself, Rega 3 turntable, Entre M/C cartridge, Lenlec head amp, Sony VFET 35 watt A class amp, Omnisonic 801 imager and full-range graphic equaliser to tune the speakers to the room.

Anyway, I consider the Permostat process one of the really great advances of the decade.

Ron Lockerbie
Merimbula NSW

Dear Sir,

Congratulations on your items on the Turin Shroud – they were the most comprehensive and interesting articles on the Shroud I have so far read, especially the one covering the scientific analysis of the Shroud.

As a Christian, my faith doesn't depend on the authenticity or otherwise of the Shroud, but one must admit that the sum total of evidence is consistent and fairly convincing, and yet incomplete; I refer to the mystifying lack of knowledge or evidence as to **how** the image was formed.

I am a science teacher, and look forward to the general science/electronics 'interface' articles as well as the electronics! Keep up the good work.

Malcolm Beck
Toowoomba Qld.

Dear Sir,

As a keen hobbyist I look forward each month to the next issue of the world's finest hobbyist electronics publication – ETI.

However, as I am a keen hobbyist I also read many other relevant periodicals, some from overseas.

Thanks to the very comprehensive nature of your project articles I have never experienced any difficulty in obtaining components or hardware for your projects, but this is not always the case with either my own special-application projects or in constructing from circuit diagrams originating overseas.

Sometimes, fortunately infrequently, I have a need for a component for which I can find no listing in any semiconductor equivalents reference book.

A case in point is that I am presently looking for a 1N2939 Tunnel Diode for an FM transmitter project. Not one supplier listed in the Brisbane phone book can find a reference to it. Further, with the exception of one or two suppliers, no-one contacted stocked tunnel diodes of any description.

My questions are:

1. What in your opinion is the best and most comprehensive semiconductor equivalents reference work on the market, for world-wide application and including semiconductors of all types (diodes, transistors, ICs, etc.)?
2. Who would be the top two or three major components stockists in Australia? That is, those who would be most likely to carry the widest range of semiconductors. I have had a long and happy relationship with the likes of Dick Smith Electronics and Tandy, but when getting into the out-of-the-ordinary one must start shopping around.
3. Any suggestions on a 1N2939 Tunnel Diode?

Bill Hely
Weipa Qld.

Thank you for your kind remarks about the magazine. I sympathise with your problems concerning uncommon components — tunnel diodes are just about the rarest devices around! Characteristics and circuits for the 1N2939 are listed in the 'G.E. Transistor Manual' published in 1964. However, regarding your first question, the most comprehensive book(s) we have come across listing semiconductor information is a series put out by a US company that specialises in this. The company is D.A.T.A. Inc., of San Diego, California. They are represented in Australia by J.H. Book Services of 75 Archer St, Chatswood NSW 2067, (02)419-7779. D.A.T.A. Inc. publish three groups of comprehensive data books: Discrete Device Services, Integrated Device Services and Special Applications Services. The books are actually periodicals, published twice a year, being updated each time. In the Discrete Device Services, they have Transistors and Discontinued Transistors, Diodes and Discontinued Diodes. The 'Discontinued' books are put out annually. Specifically you would be interested in one of the books on diodes. The books are enormous and very comprehensive and the information is arranged in such a way that you can compare and contrast devices with similar characteristics by looking at one page. However, for the average hobbyist the books are expensive bought individually (around $50), less so as a subscription but I feel many hobbyists would not be able to justify the expense. You could suggest to your local librarian though that the library take the subscription service.

Those stockists carrying a **wide** *range of semiconductors available on a retail basis change seasonally. VSI's Silicon Valley stores stock a very comprehensive range. Individual retailers such as Ellistronics, Stewart Electronics, Rod Irving Electronics, All Electronic Components, Radio Parts, George Brown's, Radio Despatch Service, Jaycar, etc, each stock a comprehensive range — the range of one overlapping the other. As to who would be the top two or three, I wouldn't hazard a guess.*

As for the 1N2939 tunnel diode, I suggest you abandon the FM transmitter project and take a look at the Radio Microphone project in the July issue of ETI's off-shoot, Hobby Electronics (Project HE 106)!

Roger Harrison
Editor, ETI.

Dear Sir,

The UHF to VHF TV converter in May's ETI is certainly a neat and timely design; however, there are a couple of points I would like to bring up.

Firstly, nowhere in the article does it mention that one of the main functions of the RF amplifier stage is to suppress local oscillator radiation. A user in a high signal strength area could well be tempted to omit the OM350 and just put a link between pins 1 and 5. In this case, local oscillator signal could well feed back up the antenna line and be transmitted.

The second point is in the 'How It Works' discussion. In column 2, second last paragraph, it reads: "Reception of a UHF station can also be obtained with this converter design by tuning the local oscillator above the channel frequency."

It is perhaps possible that reception might be obtained this way, but I expect the results would be terrible. The reason for this is twofold: TV in Australia uses a single sideband vestigial carrier system, and putting the local oscillator on the high side of a received signal **inverts** the sidebands.

If a receiver and IF strip has been designed with these facts in mind, OK, but to completely fold back the sideband and thus to lose all the effects of the specialised IF alignment would, I think, be too much.

Also, why didn't you design this unit so it could power the masthead amp previously described?

Doug Richard
Leichhardt NSW

You are quite right about one of the functions of the RF stage of the ETI-735 UHF TV converter being to suppress local oscillator radiation and we regret not making mention of it. In addition, we didn't make it clear that the local oscillator should be set to either the high side of the signal or the low side of the signal, depending on the relationship between the front end local oscillator and the IF in your TV receiver. The majority of TV receivers available in Australia have a **low side** *oscillator, we understand. Setting the oscillator for best reception will soon let you know the proper setting of the local oscillator trimmer in the converter.*

The UHF masthead amp, ETI-729, in the April issue, was designed principally for those readers who had a TV receiver incorporating a UHF tuner, and the sensitivity of the ETI-735 UHF converter was set such that a masthead amp would not be necessary, except perhaps under extreme 'fringe' conditions. You could power the masthead amp from the UHF converter's power supply, however, with the addition of one component — an RF choke having a value anywhere between 500 nH and 10 uH. Connect it between the output pin of the regulator (IC2) and the antenna input socket. This will provide +12 V to the inner core of the coax, decoupled for RF, as required by the masthead amp.

Dear Mr. Harrison,

Thank you for the enlightening article on the Shroud of Turin. An example of responsible 'social science' at its best.

All too often the voices of religion and science ignore (or sometimes berate) each other, to the detriment of both.

It is difficult for many to reconcile science and religion without the media presenting extremes and displaying ignorant, simplistic conceptions in an 'I win, you lose' format, e.g. creationism/big bang evolution. So keep up the good work.

Intriguing thought – combine a good portrait artist with the talents of, say, a plastic surgeon to come up with a 'live' depiction of the face on the Shroud?

R. Stirling
Bardon Qld.

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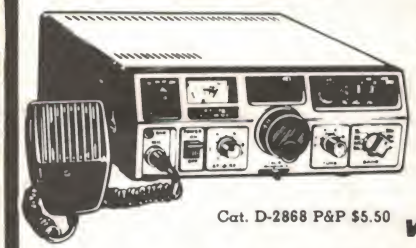

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COMMUNICATIONS

SX-200 scanner a winner!

The J.I.L. SX-200 programmable VHF/UHF scanning receiver, which was reviewed in this column in June '80, has reached a sale of 750 units since its release.

Unit 750 was purchased by Peter Walsh, a blind amateur who lives in Glenroy, Victoria. Peter is an avid listener on the HF bands and plans to extend his listening into the VHF/UHF spectrum with his acquisition of the SX-200 receiver.

The popularity of the SX-200 has been attributed to its unique design features and good performance, according to the importer/distributer, G.F.S. Electronic Imports.

Covering a frequency range of 26 to 88, 108 to 180 and 380 to 514 MHz, it uses a keyboard entry programming technique providing a selection of over 33 000 channels available to the user. Up to 16 frequencies may be placed in a non-volatile memory. Scanning can be carried out over a specific frequency range by programming upper and lower frequency limits.

Unique squelch circuitry is employed, having three modes, allowing the receiver to (a) stop scanning with open audio on carrier only, (b) to stop on carrier with closed audio until modulation is applied to the carrier, or (c) not stop at all until carrier and modulation are detected.

A front panel-mounted fine-tuning control ensures that all Australian-allocated two-way radio frequencies are covered. AM or FM reception is possible on all bands. Direct operation from 240 Vac or 12 Vdc is provided for.

We at ETI had the opportunity to review the latest model of the SX-200, which J.I.L. have improved since the receiver was first released, apparently. We found the unit to be remarkably sensitive — exceeding its specifications by quite a margin — and the front panel is not only highly functional but a delight to use. The three-mode squelch circuitry is very handy, particularly in mode (c). The three slider controls

all perform smoothly and we noted the squelch control seemed smoother than on the last unit we used.

Reception using the whip supplied, which screws into a socket at the top rear of the cabinet, is remarkably good. On an external groundplane it pulls in a host of signals! A discone antenna would undoubtedly produce outstanding results. Overall, a fine piece of equipment and good value for money.

The SX-200 sells for $499 including sales tax. For more information contact the Australian distributors, G.E.S. Electronic Imports, 15 McKeon Road, Mitcham Vic. 3132. (03)873-3939.

High-powered British CB

The British Government has allocated 40 channels and a transmitter power output of 4 W to CB radio, which will become legal in the UK later this year. (See ETI, April 1981.)

This is both more channels and a higher transmitter power than recommended by the European Conference of Postal and Telecommunications Administration (CEPT), but the British Home Office has rejected the idea that those recommendations have in fact produced a European standard. The Home Office also feels that any attempt to restrict British CB users to the recommended 22 channels and 0.5 W transmitter power would fail to produce a convincing alternative to the present illegal AM equipment that is creating so much interference.

Britain, like France, Germany and Holland will permit only FM: the present high-powered American AM equipment will remain illegal. Because of the high transmitter power, however, the new equipment will not be readily transferrable to other European countries; this is common with all European-manufactured CB equipment, and British CBers have indicated a preference for losing this facility rather than the higher power.

Should there be any general European move towards standardisation of CB frequencies, power rates, etc, Britain would be very keen to play an active part, but until this should happen the Home Office has selected a sub-band that should cause "a minimum of inconvenience to other users of radio in the UK"

Brian Dance

Money back if not satisfied ...

Telex Communications Inc. have made unprecedented claims for their Hy-Gain two-metre V-2 antenna — and backed them up with a guarantee to refund money if the purchaser is not satisfied!

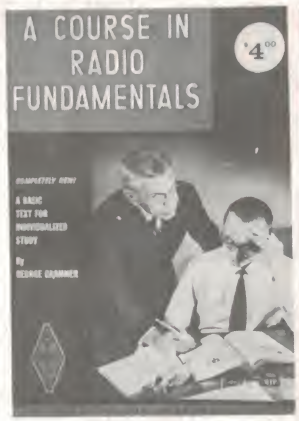
Their claim is that the new two-metre extended double zepp vertical antenna will "equal or surpass the electrical performance of any competitive two-stacked ⅝-wave antenna, regardless of gain claims".

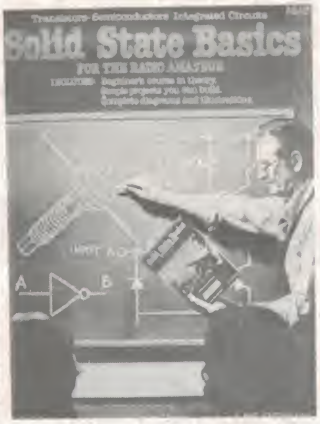
The decoupling system of the antenna allows no RF on the coax feedline, and the V-2 is said to be easy to assemble and mountable on any mast up to 50.8 mm (2") in diameter.

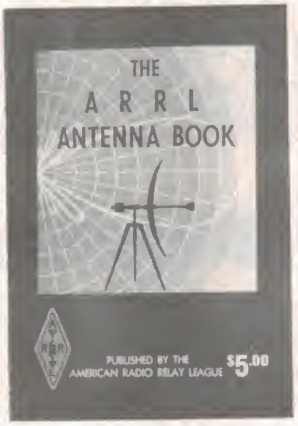
Two sets of ¼-wave radials and a centred feedpoint produce a radiation pattern that is very close to the horizon with a minimum of power loss into the sky.

The V-2 is designed to operate from 138 MHz to 174 MHz, and obtains a VSWR of less than 1.5:1 at resonance, having a 2:1 VSWR bandwidth of at least 7 MHz. The antenna's isolation from the supporting mast is 20 dB minimum.

For further details contact Audio Telex Communications, 1 Little St, Parramatta NSW 2150. (02)633-4344.







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Written by the world-renowned author, George Grammer, this book is recommended reading for anyone studying for their amateur licence, be it Novice, Limited or Full. In fact, it's a very good reference text for any enthusiastic hobbyist. The book contains 26 chapters, covering a considerable amount of basic theory from electric and magnetic fields to ac and dc circuits, resistance, reactance, transformers, RF circuits, filters, etc, to vacuum tubes and transistors, amplification, feedback and amplifier circuits. A chapter on practical experiments is included and each chapter has associated problems to work out (answers given).

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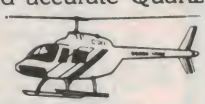

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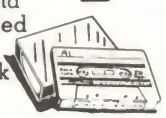

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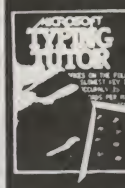

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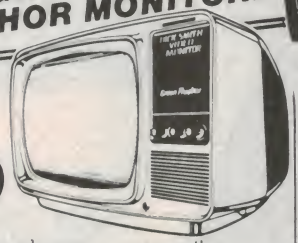

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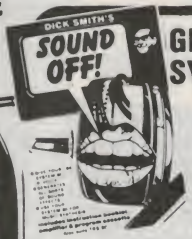

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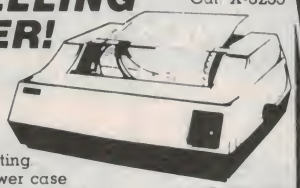

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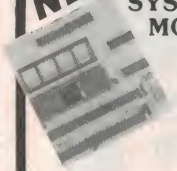

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Cat. X-3540

Owners of the System 80 and TRS-80 (Mod. 1) computers can now virtually double the storage capacity of their floppy disks, thanks to this new low cost adapter. Called the 'Doubler', the adapter unit allows existing single density disk systems to read, write and format using double density recording (modified FM).
With conventional 35-track drives, double density recording gives a formatted capacity of 175K bytes, compared with the 87.5K available with single density recording. Similarly with 40-track drives the capacity rises from 100K bytes to 200K. If 77-track drives are used, the capacity rises to an incredible 385K bytes.
One of the big advantages of the Doubler is that it retains the system's ability to operate in single density mode. This means that full compatibility is maintained with a user's existing software and data on single density disks. Recording mode is software selectable, giving great flexibility.

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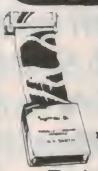

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Direct Instruction microcomputing

To date the main teaching method using microcomputers in schools has been Computer Aided/Assisted Instruction (CAI). The more recent Direct Instruction Technology offers a number of enhancements to learning microcomputing and places strong emphasis on student participation and comprehension.

CAI is a concept of teaching by machine that was introduced by B.F. Skinner at Harvard University in the USA during the late 1950s. CAI is based on the premise that the computer presents material, the student learns it, the computer tests, and students respond. There is very little emphasis placed on the student's ability to understand the mechanisms of the computer, development of individual students' programming skills or extension of students' logic.

Direct Instruction methodology ensures that all students understand the logical processes, or steps, according to individual student levels, and that students are able to master the various components essential in microcomputing. Direct Instruction is a much more interactive teaching methodology than CAI. A number of academics support the theory that microcomputing is only within the reach of the top 10% of students; CAI programs enforce this theory. Direct Instruction methodology, on the other hand, integrates teachers, students and the microcomputer to place meaningful microcomputing within the reach of all students.

Direct Instruction

Direct Instruction microcomputing comes out of Direct Instruction, a new methodology of effective teaching programs that, supported where necessary by behavioural management, literally and most effectively teach every child. Direct Instruction programs are incredibly flexible; the most 'retarded' to the most gifted' of children can be extended by them.

Programs teach the essential or required skills across a range of over thirty programs including reading, spelling, maths, languages, creative writing, cursive writing, microcomputing, etc.

Direct Instruction recognises individual differences by ensuring that the child is taught at an appropriate level in each of his skill areas, and that different motivational strategies are used when necessary. The instructional strategies, where reasoning replaces rote learning, ensure that a small amount of learning is specifically made to generate disproportionately large areas of self-generated learning.

Over the past decade classroom research has looked at 'good' teachers and 'good' students to try and tease out contributing factors. International and Australian work in schools has elicited about ten factors that are known to contribute to effective teaching and effective learning. These factors are:

- an emphasis on mastery learning
- ensuring that students are heavily engaged in academic content areas
- use of structured teaching procedures
- a focus on teacher-centred classrooms
- directly teaching children in small or large groups
- using the demonstration-practice-feedback teaching procedures
- an emphasis on high achievement and scholastic excellence
- establishing success patterns in learning where errors are minimal
- an emphasis on teaching the general case or rule – i.e: identifying the minimum set of 'building blocks' which can be used to help students perform the maximum number of tasks.

Independent educational researchers, drawing together the pattern of classroom evidence incorporating these factors, termed the most effective teaching model produced 'Direct Instruction'.

Direct Instruction microcomputing is based on the notion that all learners can perform and achieve to high competency levels, provided they are taught effectively. Whether or not the learners do achieve depends on our instructional strategies and how well we are trained in Direct Instruction microcomputing.

A workshop on Direct Instruction microcomputing will be held at Macquarie University on September 10 and 11 this year. The workshop has been designed to encourage 'hands on' experience in the use of microcomputers for parents, teachers and beginners. Instructors have been specially selected from universities, schools and the computer industry. Practical workshops will be conducted on both days.

Computer Reference Guide at Chatswood (publishers of the Australian Microcomputer Handbook) will publish papers from the workshop; these papers will be produced in book form and will provide an invaluable reference for all parents, teachers and students.

Additional information about the workshop and publication can be obtained from Mrs. Joan Booth, Secretary, AADI Teacher Training Institute, 20 Ronald Avenue, Ryde NSW 2112. (02)38-3424.

New Commodore VIC from Edible Electronics

Edible Electronics have released more details on the new Commodore computer due for release around September this year.

Called the VIC, which stands for Video Interface Computer, it is designed to plug into any standard colour television and will probably sell for under $500.

The unit has a full-size keyboard with four user-definable keys which perform eight functions. The display is 22 characters wide by 23 lines, utilising 64 ASCII characters and full PET graphics.

The VIC produces eight background colours, sixteen foreground colours and eight character colours. It has four 'voice' sounds including a sound effects generator. The VIC comes standard with PET BASIC and 5K of RAM, which can be upgraded to 32K.

The VIC is designed to take advantage of a wide range of accessories to be available later, including a single disk drive, printer, joysticks, paddles, lightpens, high resolution graphics, etc.

For further details contact Joel Gotlib at Edible Electronics, 50 Park Street, Abbotsford, Melbourne, Vic. (03) 41-5708.

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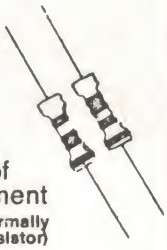
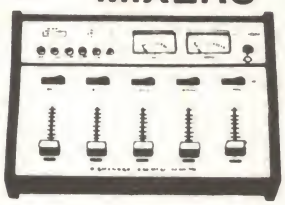
2708	$6.50	$5.90
2716	$7.90	$6.90
4116	$2.90	$2.30
2732	$17.90	$16.90
2114	$2.75	$2.40
2114 LP3	$2.80	$2.50
Z80 P10	$5.90	$5.25

FREE!! 250 pack of resistors on purchase of over $10 on presentation of this advertisement **Save $10** (Normally 4¢ per resistor)



NEW

AUDIO MIXERS



• 2 Hi-Low microphone inputs • 2 Magnetic/Ceramic phono inputs • Also tape and tuner inputs • 2 VU meters • Stereo or mono • Independent CUE on each chan • Compact size, 26 x 20 x 6.5cm • 9V battery operation, ext DC input socket

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PRO Model

• Facilities for 4 stereo program input and 2 mic. inputs • Built-in low noise preamplifier for magnetic phonos and low or high impedance microphones • Professional stereo slide controls • Headphone circuits to monitor each input and output • Talk switch to attenuate music volume 14db so mic's can be used without readjusting music levels • 5 channel stereo graphic equalizer section using separate slider controls • Meters monitor the output of left and right channels independently

$169

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With this great little kit you don't have to bother about thinking up numbers anymore. It features 40 LEDs and tells you what numbers to choose. Great for picking a winner.

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Are you sick and tired of that boring voice? Build this delightful little kit and impress your friends with the Cylon Voice.

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'LE GONG' door bell kit

Are you sick of ding-dongs? You don't have to spend a fortune to hear a pleasant sounding doorbell. This great little kit does the job simply and cheaply. (pushbutton not included)

$15.00

REGULATORS

	1-9	10+
7805	90c	80c
7812	90c	80c
7815	90c	80c
7818	90c	80c
7824	$1.00	90c
7905	$1.20	$1.10
7912	$1.20	$1.10
7915	$1.20	$1.10
7924	$1.20	$1.10

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• 8-12 V DC operation • 225 OHM coil resistance • Silver change over (S.P.D.T.) contacts handle up to massive 2 amps at 24 V DC or 100 V AC • Mounts directly on to PCB • Ideal for many applications

SAVE	1's	10's	25 up
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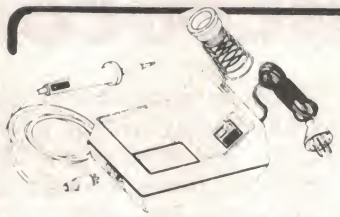

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A transformer powered soldering station, complete with a low voltage, temperature controlled soldering pencil. The Special Weller features a 'closed loop' which controls maximum tip temperature, thereby protecting temperature sensitive components while the grounded tip protects voltage and current sensitive components. Features: • quick connect/disconnect plug for the soldering iron • extra large wiping sponge • tip tray to store extra tips • 2m flexible 3-wire power cord.

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LCD PANEL METER KIT

This economical evaluation kit features on-board clock and reference, accuracy guaranteed to ± count over entire ± 2000 counts, single reference voltage for ratiometric operation plus many more important features. Kit includes PC Board & hardware, A/D converter, LCD display, resistors, capacitors, wiring diagram, application notes and data sheet (power supply not included).

$34.50

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130 mm DUAL-TRACE 15 MHz, TRIGGERED SWEEP OSCILLOSCOPE

TRIO $555

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*Very easy X Y operation of high input sensitivity for Lissajous measurements

*Dimensions 260(W) × 190(H) × 385(D) mm. Weight 8.4kg.

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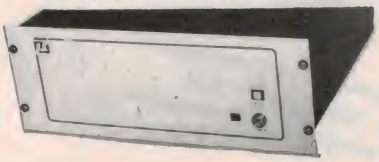
S100 MICROCOMPUTING

MICROTRIX

Microtrix is an Australian manufacturer and supplier of a comprehensive range of S100 products, from single boards to complete computer systems. We only market products that meet our exacting standards of quality, reliability, and efficiency of design. Our own state-of-the-art projects as well as those of S.D. Systems, a Dallas-based manufacturer of high quality components, are supplied. All our cards are internally compatible, being integrated into a powerful microcomputer system by specially written software. Considerable expansion capability is built into our systems from conception, meaning that any system can be inexpensively upgraded at any time.

MICROCOMPUTER



This is our professional 12 slot S100 mainframe. It features a serial port, a parallel port, a shielded motherboard, 64K of RAM, 2K monitor, up to 16K PROM, counter/timer, heavy duty power supply, mains filter, and cooling fan.
MCS 200 — 64. **$1640.**

SBC 200 SINGLE BOARD COMPUTER

The original single board computer with 1K RAM, 2K monitor included, up to 16K PROM, counter/timer, serial port, parallel port, 4 MHz, software programmable baud rate generator. High quality imported PCB with solder resist mask and component overlay. Beware of low quality local copies.
With monitor. Kit **$400.** A/T **$470.**

MPC-4 MULTI-USER INTELLIGENT I/O

A brilliant new board from S.D. Systems. Features on-board Z-80 CPU, 1K RAM, PROM, 4 serial I/O ports, and a counter/timber circuit. Ideal for multi-user and communications work. All inputs and outputs are buffered. Interrupt driven. Software programmable baud rate generation for each port.
Kit **$635.** A/T **$715.**

VDB 8024 VIDEO CARD

Contains on-board Z-80. I/O mapped. 80 x 24 display. CRT 5037 video controller chip. On-board software and character generator in PROM, easily changed if required. Full 96 character upper and lower case ASCII set. Special characters also available. 2K RAM.
Kit **$460.** A/T **$530.**

VERSAFLOPPY 2

Industry standard controller. Single/double density, single/double sided. IBM format compatible. 8" and 5¼" discs. PLL data recovery for reliable operation. Vectored interrupts optional. Control and diagnostic software available. Operates with either SDOS or our CP/M 2.2.
Kit **$375.** A/T **$435.**

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State-of-the-art dynamic RAM card. Operates at 4 MHz. Expandable from 16K to 256K on board. Bank select, ideal for multi-user systems.
While stocks last.
16K Kit **$330** A/T **$400**
64K Kit **$435** A/T **$505**

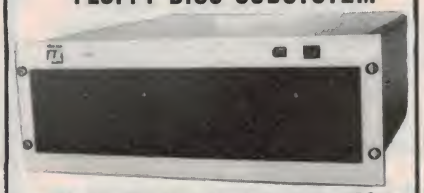
VERSAFLOPPY 2, DDBIOS, SDOS

A new package from S.D. Systems and Microtrix. Everything you need to add floppy disc capability to your S100 system. Comprising the Versafloppy 2, DDBIOS PROM, and SDOS, a powerful CP/M compatible operating system.
Includes new documentation.
Kit **$480** A/T **$540.**

VISUAL 200 VDU

A brilliant Z-80 based intelligent terminal. Emulates ADM3A, Hazeltine 1500, ADDS 520, and VT52. Many switch selectable features. RS232 and 20mA current loop. Printer port. Self diagnostics. Full cursor control. 31 character graphics set. Function keys. Slow scroll. Detachable keyboard with capacitive keys.
$1295.

FLOPPY DISC SUBSYSTEM



Now supplied with double-sided, double-density YE Data drives, our companion floppy disc unit features cooling fan with washable filter, mains filter, and electronically protected power supply. A very professional unit.
FDS 400 **$1750.**

PROM 100 PROM PROGRAMMER

Turn our computer into a development system. Programs 2708/2758/2716/2732 EPROMS. Dip switch selection. Zero insertion force socket standard. Software available for SDOS, in PROM, or our own menu-driven CP/M 2.2 compatible utility.
Kit **$250** A/t **$295.**

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Our philosophy of expansion is evident in our multi-user systems. A standard single-user system can be easily upgraded to multi-user capability, and a two user system can be expanded to cater for up to five terminals. The two-user system is particularly attractive, being a simple and inexpensive upgrade. For more than two users, the MPC-4 intelligent input/output board is required. In both cases, the operating system is the powerful COSMOS multi-user software.

2-user system	**$5365**
Including Visual 200's	**$7955**
5-user system	**$6995**
Including terminals	**$13450**

SOFTWARE

SDOS 1.8 Single user, CP/M compatible operating system developed by S.D. Systems (USA) for our range of boards. Various utilities. including a Z-80 assembler, Linker, Loader, Editor, and others are included. Single or double density. **$210**

CP/M 2.2 Industry standard operating system with our own BIOS that dynamically checks and changes between single and double density depending upon the diskette used. Our unique Sysgen program allows the user to easily tailor the software to suit his requirements. Standard **$165.** Microtrix **$210**

Note: All our software is genuine, sold with licensing agreement.

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8" double sided, double density floppy disc drives. Excellent value. **$650.**

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Z80 Starter Board Programming Seminar: **$80**
A 2 hour session on how to program with our Z80 Starter Board for beginners. Enquire for bookings and further details.

FREE: Programming Seminar with first five Z80 Starter Kit packages sold.
FREE: Workshop Seminar with first five S100-Bus Board Kits sold.

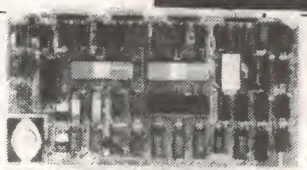
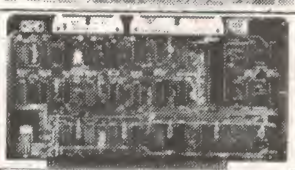
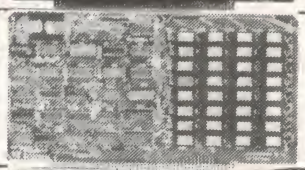
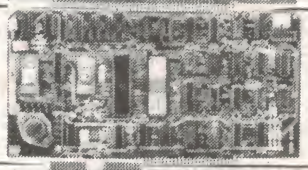
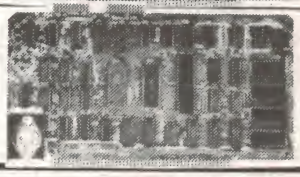
HARDWARE:

Z80 Starter Kit: **$420 — Kit. $480 — A&T.**
Z80 CPU with 158 Instructions, On-Board Keyboard and 7 segment Display, On-board PROM Programmer for single voltage PROMs (2716, 2758, TI2516), Kansas City standard cassette interface with simple controlled load and dump, expansion provision for two S-100 connectors (sockets not included), wire wrap area for custom circuitry, single step through RAM and PROM, memory examine and change, port examine and change, Z80 CPU resister and change, 2K byte ZBUG monitor in ROM, 1K bytes of RAM (expandable to 2K bytes), counter timer (Z80-CTC), parallel I/O ports (Z80-PIO), up to 5 programmable breakpoints, switch selectable PROM or monitor restart, vectored interrupts provided by Z80-CTC and Z80-PIO.

Computation **Monitor** PROM (2716): **$120.** FREE: with every SBC-200 sold.
Features commands to develop machine language programs including the manipulation of memory locations and I/O port data, breakpointing and single stepping. In combination with the computailor BIOS PROM it provides a comprehensive range of disk management primitives.

Computailor **BIOS** PROM (2716): **$120.** FREE: with every VERSAFLOPPY II sold.
Features routines to execute disk operation for single density, double density, single sided, double sided, 5¼" and/or 8" drives. Obeys CP/M BIOS calling conventions and is hence suitable for SDOS, CP/M, COSMOS and MP/M operating systems. Contains comprehensive cold boot routine for most disk operating systems.

S-100 BUS SINGLE/MULTI USER MICROCOMPUTER SINGLE BOARD GUIDE:

Number of boards per system.	Board		Features	UNIT COST Kit $	UNIT COST A & T $
	Any S100 Standard Board: Prom Programmers, A/D -D/A Converters, Expandoproms, Hard-Disk Controllers, General I/O Boards.		RING FOR DETAILS		
4 Boards for 16 User System.		MPC-4 Multi-Port Communicator	Z80-CPU, Real Time Clock, Progr. Baud Rate Gen., 1K RAM (Static), 2 x Z80-Darts, 2K PROM (2716), Fifo Buffer, Z80-CTC.	$600	680
1 Board for single or 16 User System.		VERSAFLOPPY II Floppy Disk Controller.	2K Bios PROM (2716), IBM 3740 Standard Single Density or Double Density, Single or Double Sided Drives, 5¼" and/or 8" Drives, up to 4 Drives.	$425	$485
			Free: Computailor Bios PROM (2716).		
1 Board for Single User, 8 Boards for 16 User System.		EXPANDORAM II Dynamic Ram Card	Expandable Dynamic Memory 16K-256K, Selectable Boundaries, Up to 4 MHz Operation, Phantom Output Disable, Page Mode Operation, Uses 16K (4116) or 64K (4164) Memory Devices.	$360 16K $440 32K $520 48K $600 64K	$420 $500 $580 $660
1 Board for Single or Multi-User System.		VDB-8024 Video Display Board	80 characters x 24 lines, 7 x 10 Matrix, Composite or TTL Video Output, Keyboard Power & Interface, Forward & Reverse Scrolling, Blinking, Underlining, Field Reverse, Field Protect and Combinations, Full Cursor Control, 96 Upper and Lower Case Characters, 32 Special Character Set, 128 Additional User Programmable Characters (Optional), On-Board Z80-CPU, 2K BYTES Independent On-Board Ram Memory, Glitch-free Display.	$450	$520
1 Board for Single or Multi-User System.		SBC-200 Single Board Computer	Computailor Monitor 2K PROM (2716), Z80-CPU, 1K RAM, 16K EPROM, Serial I/O, Parallel I/O, Z80- CTC, 4MHz Operation, Optional Vectored Interrupts, Power-on jump to 4K boundaries, On-board memory can be switched out under programme control.	$395	$465
			Free: Computailor Monitor PROM (2716).		

FULL SYSTEMS:
Any configuration from a simple dedicated system or a single user system to the most complex multi user system. Arranged with a selection of floppy disk drives, hard disk drives, printers and VDUs.

PERIPHERALS:
VDUs, printers, disk drives, etc.

SOFTWARE:

Single user SDOS 1.6 operating system	$200
Single user CP/M 2.2 operating system	$160
Multi user COSMOS operating system	$380
Multi user MP/M 1.1 operating system	$310

Enquire for customized operating systems. Pascal, BASIC, FORTRAN, Word processor (Wordstar) and Utility programs are also available on request.

Ask for our short form catalogue.
All prices are tax free; add 15% sales tax if applicable.
Mail orders are welcome, add $3 — postage.

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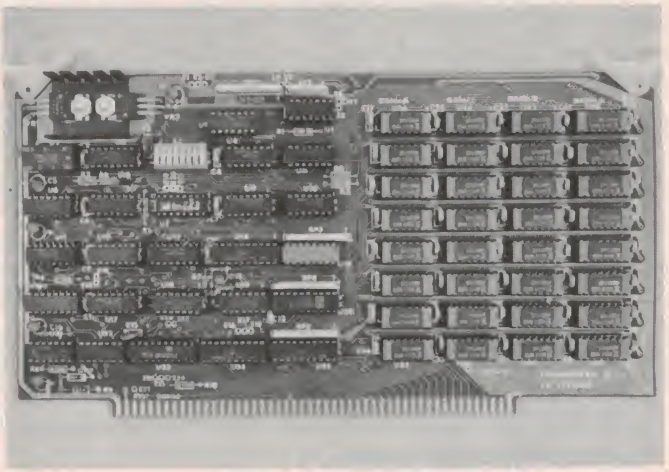
Print-out

Versatile RAM kit from SD Systems

The Melbourne-based company Microtrix recently introduced a range of S100 microcomputer boards from SD Systems of the US here, and we had the opportunity to review their ExpandoRAM II kit back in June.



The ExandoRAM II kit is available in two versions: 16K and 64K. The memory array consists of up to 32 dynamic RAM chips organised into four banks of eight RAMs each. (Where's the shepherd?). The eight RAMs each contribute one bit to an addressable location. The total capacity is either 65 536 or 262 144 bytes, depending on the chips employed. Included on board, apart from the memory array, is circuitry for memory decode and control, address multiplexer and data buffer.

The memory decode and control section is responsible for generating the timing signals for the memory array, address multiplexer and data buffer. Timing within the memory decode and control section is generated by a TTL-compatible delay line. An 82S130 PROM is used to select the proper banks according to the address lines, board select (DIP) switches and the board select latch.

The address multiplexer is responsible for taking the address bits from the address buss buffers and multiplexing the proper row and column address into the memory array under control of the memory decode and control section.

The data buffers (controlled by the memory decode/control section) isolate the memory array from the data buss. Also included is a Port FF Board Select which decodes the port FF and latches the output port data on the board.

Our ExpandoRAM II for review arrived already assembled. The board is standard S100 size and is relatively uncluttered despite the large number of ICs employed. Sockets were used for all the chips and the board is silk-screened on the component side to assist the constructor to locate the parts. Conveniently, all ICs face the same way. The board is double-sided with plated-through hole construction, solder masked with gold-plated pins on the edge connector.

The instruction manual supplied is clearly written and circuitry and timing diagrams are supplied, along with a complete parts list. Reproduction of the board overlay is not terribly good, but parts location should be easy owing to the silk-screening on the board. A checkout procedure is given in the book, along with a memory diagnostic software listing.

We tried the board in a system using the SD Systems SBC200 CPU card (just coincidence, really) running at 4 MHz with no WAIT states. A DTC1403D disk controller was installed in the system, driving a Shugart 10M hard disk. The ExpandoRAM II performed faultlessly. For around $400 tax paid this kit offers good value for money.

As a parting note, you can plug in 64K chips to make a 256K board — if your bank manager has sufficient discretionary allowance to advance you the loan!

Further enquiries should be addressed to Microtrix, P.O. Box 158, Hurstbridge Vic 3099. (03) 718-2581.

'Computailor' – customised computers

Computailor Pty Ltd was formed by two enthusiastic men with a combined background embracing both variety and experience.

Lutz Bilko, Computailor's administrator and electronics technician, began his career in 1959 as an apprentice with the Brown-Boveri Werke AG in Austria. After comprehensive training and both practical and theoretical experience he went to work for the Westinghouse Brake and Signal Company as a technician, and following this he was employed as a research technician in the Department of Electrical Engineering at the University of Melbourne. He specialised in designing and implementing digital electronics circuitry as well as maintaining various computers and peripherals.

Chris Price, Computailor's design and sales engineer, obtained his First Class Honours degree as a bachelor of electrical engineering in 1978 and completed his Master's degree in 1981 at the University of Melbourne. As a student he covered electrical theories as well as computer science. Today he is an authority on several high and low level computer languages, notably Pascal, Cosmos and MP/M.

With the combined knowledge and varied experience of Lutz and Chris, they are confident that Computailor can successfully design and tailor computer software and hardware to provide a professionally customised computer system for both the community and industry.

Chris Price

Lutz Bilko

A distributor contract from the USA provides Computailor with a ready range of highly proven S-100 computer boards, along with low and high level language software for single user and/or multi-user. Word processors and computer peripherals are also available.

Computailor can be contacted at 23 Bennett St, Bacchus Marsh Vic. 3340.

Printout

Commodore 8032 alternative to 'dumb' terminal

B.S. Microcomp have announced the release of the MICROCOMMS package, which enables the Commodore 8032 microcomputer to be used as a terminal for other computer systems.

The package consists of an 8032 with a serial interface and communications software. Optional extras are an 80-column printer which uses continuous fan-fold paper and a floppy disk for data storage.

Originally designed to be used with Telecom DATEL lines at 300 baud, the MICROCOMMS package has been used successfully up to 4800 baud.

The specially developed communications software turns the 8032 into a VDU with 24K of scrollable screen memory. This means that the user can connect to a remote computer to interrogate a database and have the entire dialogue stored in the 8032's memory. The connection can then be terminated and the dialogue printed out in whole or part and/or stored on disk or tape.

When this capability is added to the large range of existing software for the 8032, it is claimed that it becomes a viable alternative to the mainframe-dependent 'dumb' terminal.

For more information contact B.S. Microcomp, 4th Floor, 561 Bourke St, Melbourne Vic. 3000. (03)614-1433.

The review of Spellguard software published in the July 1981 issue of ETI was substantially based on material by Bill Burns, published in the March 30th 1981 issue of InfoWorld, and should have been acknowledged accordingly. Our apologies to the parties concerned.

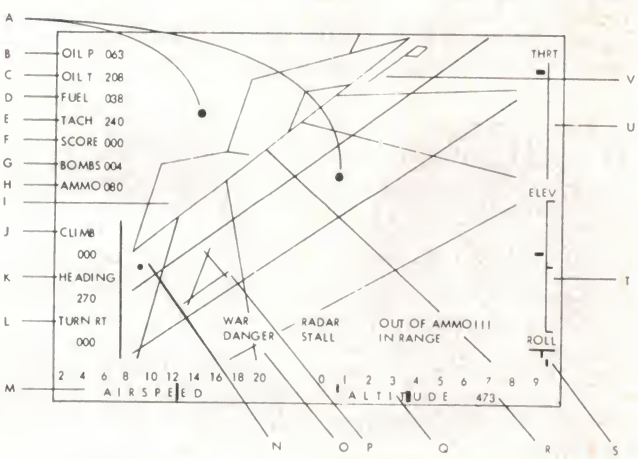
Come fly with me

Dick Smith Electronics have released a computer program for their home personal computer that teaches you to fly a plane without even leaving your loungeroom!

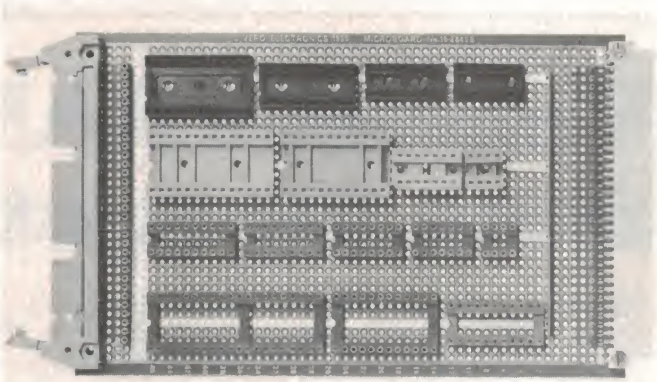
The X3684 Flight Simulator Program is claimed to teach you the laws and theory of flight in three dimensions. You can become a 'British ace' and fly aerial battles armed with machine guns and bombs, can participate in dog fights and do aerobatics.

Full instrumentation is provided, plus the 'out-of-the-window' 3D dynamic flight display and radar, all for only $34.90.

Full details are available from all Dick Smith stores.



A Enemies on 3D screen
B Oil pressure (psi)
C Oil temperature (degrees F)
D Fuel (gallons)
E Tachometer (rpm)
F Score (1 per fighter, 1 per bomb hit)
G Bombs remaining
H Ammunition remaining
I 3D out-the-windshield display
J Climb rate (feet per minute)
K Compass heading (degrees true)
L Turn rate (degrees per minute)
M Airspeed (mph)
N Enemy fuel depot
O Status messages (6 in all)
P Enemy airbase (three runways)
Q Altimeter (feet)
R Micro-altimeter (feet) when below 700 feet only
S Roll rate indicator (rudder position)
T Elevator position indicator
U Throttle position indicator
V British airbase



Micro-board Eurocards for microprocessor applications

Micro-board Eurocards — the first of their kind to be specifically designed for microprocessor applications, where compatibility, flexibility, high density and screening are of prime importance — are now available from Warburton Franki.

The boards, which are compatible with all sub-rack systems conforming to IEC 297 and DIN 41494 specifications, have power rails running beneath dual-in-line packages, allowing high packaging density and easy decoupling. They may be hard-wired or wire-wrapped.

DIN 41612 connectors can be positioned for front and rear mounting, with the added facility for interfacing the front of the board using ribbon cable headers in up to 60 ways.

Other features include colander ground plane, which is provided for maximum screening between component and wiring sides, full alphanumeric grid references on the wiring side, solder resist coating and screen printing on the component side of the board.

For further information contact Warburton Franki Ltd, 372 Eastern Valley Way, Chatswood NSW 2067.

Conversation with a computer?

The UK National Physics Laboratory claims to have produced a system of speech recognition that can handle any person's speech.

The system, the result of ten years' work, is said to be able to handle speech from a person who has not communicated with it previously, unlike most systems, which require training with each individual speaker who is to use the equipment. The vocabulary is also said to be much wider than in other systems.

The equipment breaks up the speech into 16 constituent sounds, similar to phonemes but not linked to any particular language like normal phonemes. Analysis of the sound leads to the identification of words, whereas most other speech recognition systems work by identifying the waveforms associated with each word.

The system is also said to show great improvements in the identification of strings of words spoken together, as in normal speech — one of the most difficult problems of speech recognition systems. It can detect key words in the middle of a flow of words, which is said to be beyond the ability of systems currently on the commercial market.

The probable areas of application for the NPL system range from office and business systems to avionics/defence and industrial process control. The Laboratory has formed a technology transfer club which companies can join for between STG£8000 and STG£10 000 per year; these subscribers receive all the details of the system so far developed, and will help to formulate the research and development programme into speech recognition.

Brian Dance

New edition of Optoelectronics/Fibre Optics Applications Manual

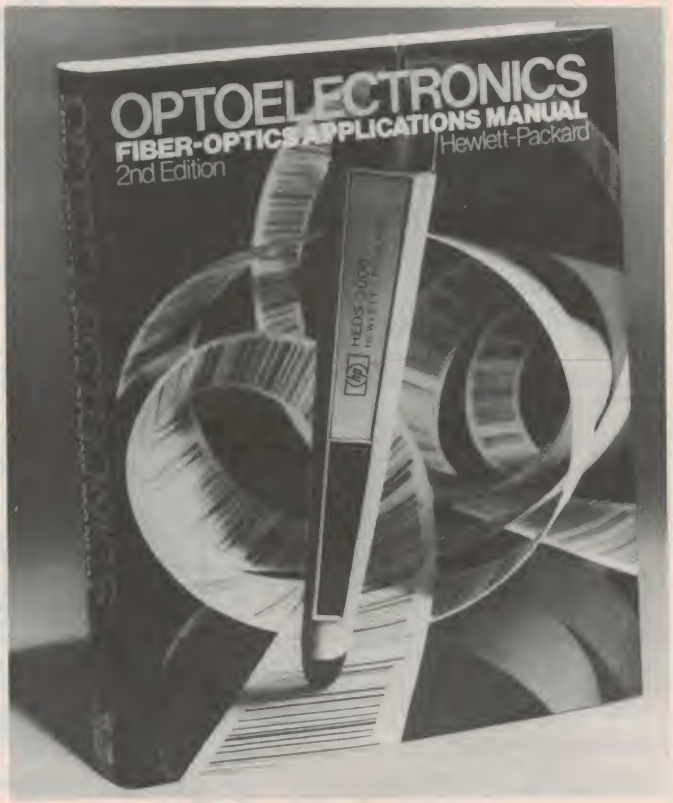
Because of the growing complexity of today's optoelectronic product applications and the problems associated with them, Hewlett-Packard's optoelectronics division has written a second edition of the Optoelectronics/Fibre Optics Applications Manual, HPBK-2000.

This hard-cover, over 400-page book discusses possible solutions to the most common problems that arise in the application of fibre optic systems, optocouplers, emitter/detector and digital bar code systems, and optoelectronic displays and lamps.

In addition, such subjects as photometry/reliability of optoelectronic components and the mechanical handling of optoelectronic components are covered. Circuitry and software examples are given which can be used directly in circuit designs.

Each of the major sections covers the theory of a particular area of technology, the theory behind products designed to service needs in that area of technology, and practical solutions to technical problems encountered in the area. Enough theory and technical analysis are provided for each application so that the solution can be easily extended to other applications.

The Optoelectronics/Fibre Optics Applications Manual can be ordered and purchased from Hewlett-Packard's authorised distributor, VSI Electronics, at $25 Aust. and $30 N.Z.



British Telecom to launch Teletext service

Peter Benton, Managing Director of British Telecom, has announced that early next year Telecom will provide a high speed desk-to-desk message service to open up the era of the electronic office.

This new service will offer Teletext users the ability to prepare and edit correspondence, together with the means of accurately and rapidly conveying the information to a distant terminal. In a typical case, a full page of text will be transmitted in a few seconds.

The users of this service will be able to type letters, internal memoranda and other messages on their terminals as if they were using ordinary typewriters, and their correspondence will then be sent over the telephone network. The setting up of the calls, their transmission and reception will be fully automatic without anyone having to be present at either end.

Telecom's primary role in the new service will be to provide the network; it is expected that British industry will supply the terminals Various manufacturers have already stated that they intend to proceed with the development of suitable terminals. In its simplest form a terminal can be an electric typewriter with a communication facility, but a more complex unit can include a multi-function visual display unit with word-processing and other software packages to perform a variety of specialised business functions.

Initially the Teletext service will use the public telephone network and the packet-switched data service, but shortly afterwards connections will be provided with the telex network, thus enabling Teletext customers to communicate directly with 90 000 telex terminals in Britain and with about one million telex users overseas.

Mr. Benton stated that Telecom are at present discussing arrangements for an international Teletext service with Sweden, Belgium and West Germany, but in due course the service will be available to many countries.

Teletext messages will be transmitted at rate of up to 3500 words per minute compared with the 80 words per minute of telex. The resulting short calls should sharply reduce delays owing to the called terminal being engaged, but if the remote terminal is busy, the sending terminal can automatically try again later. A terminal can be programmed to automatically transmit a series of messages in turn, calling up each of the numbers required in sequence until all the messages have been transmitted.

Brian Dance

New single-board computer from Intel

The iSBC 86/05 Single-Board Computer was introduced recently by Intel Corporation as the second low-cost member of the iSBC family of multibuss-compatible architecture 16-bit microcomputers.

The board features an Intel iAPX 86/10 microprocessor with an 8 or 5 MHz clock, and is compatible with the iSBC 337 Multimodule Numeric Data Processor, which employs !ntel's 8087 arithmetic chip.

Two iSBX interfaces are present for simplified on-board expansion with the iSBX Multimodule board series.

The board has 8K bytes of RAM and capacity for 32K bytes of EPROM. Both capacities can be doubled directly on the board using the new iSBC 302 RAM Multimodule and iSBC 341 EPROM Multimodule boards. These provide 8K of RAM and capacity for 32K of EPROM respectively, resulting in a total on-board memory capacity of 80K bytes.

System memory can be expanded beyond the on-board capacity up to one megabyte by using any of the multibuss-compatible boards available, including both semiconductor and magnetic bubble memories in the iSBC product family. Mass storage can be further enlarged by adding single or double density diskettes or Winchester and SMD hard disk controllers.

Two programmable interval timers, 24 parallel I/O lines, a serial I/O port with programmable baud rates, and nine levels of vectored interrupt control are standard board features.

Intel also introduced the iRMX 88 Real-Time Multitasking Executive, optimised for small size and high-performance applications.

Complete software development support is available with the Intellec family of development systems, languages and debugging facilities.

For further information contact AJF Systems and Components. 310 Queen St, Melbourne Vic. 3000. (03)67-9306.

Print-out

For Sorcerer Apprentices

The backlog of Sorcerer mail both here and waiting for me at the ETI offices has reached such mountainous proportions that I think Australia Post must believe by now that 'Sorcerer' is a code name for mail order pornography. However, many apologies to all those who are still waiting for an answer or for an evaluation of a program they have sent in; my excuses are many and varied but all true.

Firstly, I have to earn a living as well as answer Sorcerer mail; secondly, some of the questions asked are so complex that it takes me some time to sort out the answers; thirdly, even if I do prepare an answer and get it to Roger, it will then be six to eight weeks before you read it in ETI because of the publishing deadlines. And on top of all that, much as I would like to appropriate the majority of ETI's pages for Sorcerer information, space is limited, and I can only answer a few letters a month. So please have patience and bear with me till the backlog is cleared.

Here goes with a few queries and program suggestions:

Dear Sir,

I am writing to ask for your help in several questions I have about programming the Exidy Sorcerer in machine language.

Firstly, is it possible to turn off the cursor completely during cursor movements? Secondly, is it possible to generate random numbers in machine language? Thirdly, could you tell me how to do trig. functions in machine language?

Yours, Rex di Bona

Dear Editor,

I have been reading your column for Sorcerer computer users since it started, and now, like many others, I have needed to try three-dimensional graphics — and that is where the problem starts.

I became curious about using specific subroutines within the ROM PAC in my own programs, but to do this I need to know the location of the routines and the way data flows in the routine.

The questions I have are: What are the locations of the mathematical function and operator routines in the ROM PAC, the position where the data and results are placed, and the format of the code used in these routines?

If this is not possible, could you please give examples of how to calculate sin, cos, etc, in a machine language routine?

Yours, Arthur Raiskio

Thanks to Arthur and Rex for their interesting questions. I assume that Rex wants to turn off the cursor completely in order to avoid the little white lines jumping to a position where printing begins. You cannot, however, turn off the cursor by software unless you write your own video driver. I suggest you use an instant cursor positioning program. There are several such programs around, but my preferred one is the one by John Woolner, which uses the OUT function. (If the OUT statement is used as intended, the initial values are poked back in, prior to use (PEEK 231 for right value.) Here it is:

```
1000 RESTORE 2000
1001 FORW=32TO61:READA:POKEW,A:NEXT:POKE262,231
1010 REM lines 2000 — 2002 are data for cursor positioner
1020 REM lines 1000 & 1001 initialise cursor positioner
1020 PRINT "Cursor is currently here"
1030 OUT 25,25 : PRINT "and now here
1030 OUT 5,15  : PRINT "here
1040 OUT 15,5  : PRINT "and now here
1050 OUT 25,25 : PRINT "see how it works ?
1060 REM please note that the program does NOT verify if
1070 REM the parameters passed through the OUT statements
1080 REM are within the limits of 30 lines and 64 positions
1090 REM We trust you'll make sure of this yourself.
1100 PRINT CHR$(12) : OUT 15,20 : PRINT "HAPPY COMPUTING
2000 DATA229, 71, 205, 232, 233, 175, 253, 119, 107, 203, 24
2001 DATA31, 203, 24, 31, 253, 119, 104, 253, 112, 105, 58, 63
2002 DATA1, 253, 119, 106, 225, 209, 201
```

Random numbers in machine language can be generated in several ways. But no random numbers are really random unless you "seed" them. This is normally done by asking for a name or the date. A very simple machine language random number generator is listed below:

```
KEY     EQU   0E009H    ;Exidy RECEIVE
START:  PUSH  HL        ;save it
                        , our random
                        ;number is there !
        CALL  KEY       ;call the keyboard

        JR    NZ,GOT IT ;someone pressed it.
        POP   HL        ;restore random number
        INC   HL        ;we count up
                        ;if higher than FFFF,
                        ;who cares ?
        JR    START     ;wait till key pressed

GOT IT: POP   HL        ;that's it
        RET             ;we have a 16 bit
                        ;random number in HL
                        ;or two 8 bit in H + L
```

The fully relocatable object code of this is:
E5 CD 09 E0 20 04 E1 23 18 F6 E1 C9

Should you question the number's randomness, try getting the same number twice! Naturally, the assumption here is that at one stage or another you'll have to call a keyboard entry routine, but then I have never seen a program which does not do just that. I assume you require the function for a game or similar type of program, for which the above is quite satisfactory. Should you require a random number generator for statistical programs, where it is vital that you can prove the number is a random number, write to me again and I'll publish a more complex generator. Let me remind the novice that this program will NOT operate as a subroutine to your BASIC program, since it is written in Z80 Assembler language. Use the RND (random) function in your BASIC program if you need random numbers.

The question of trigonometry and its calculation is a different kettle of fish. The whole complexity of such calculations is very neatly and easily solved by using the routines provided in the BASIC PAC. This means that the program using the functions is dependent on the PAC being resident during execution. I spent several hours in the middle of BASIC and can report the following: it is difficult. BASIC uses the following addresses for the corresponding functions:

LOG 0D4ABH; SIN 0DA14H; COS 0DA0EH; TAN 0DA75H, ARCTAN 0DA8AH

Arguments are passed through the floating point accumulator, residing from 01BFH to 01C3H (447 to 450 decimal). At this stage, I cannot tell you exactly how to set up the registers. I suggest you try out different combinations and check the results which are passed back into the floating point accumulator. If anyone is successful she/he might send in the solution. I am sure it will be much appreciated by other readers.

Those of you who remember the second-last column may recall my asking for some programs for evaluation. The response was not overwhelming, but nevertheless interesting.

This month I'll report on three programs supplied by Customized Technology: CASSETTE FILES, BASEBALL and GRAPHICS. Let's examine Cassette Files first.

The program's main function is to read and record your variables from your Exidy BASIC programs. Documentation is good, with a sample program provided (in print only). Cassette Files relocates the BASIC stack and then relocates itself above that area. Of course, this means that you lose some of your memory to the program. The program uses the USR function; strings and arrays are passed to it and it will then allow you to place or retrieve them to and from tape. Writing to tape is done automatically once the buffer is full, while you can read one array after the next. Gone are the days of troublesome and frustrating CSAVEing and CLOADing. The recording quality of ▶

Printout

Cassette Files is good; I bought software that took several days and several machines to load, and I had no CRC-errors and it loaded first off. Cassette Files is reasonably priced at below $20. Next month I'll review String Saver, another program of the same type.

As its name implies, BASEBALL is a computerised baseball game. If you have kids, you may keep them amused for a couple of hours with this program, but to my mind, while the graphics are quite good, it's just another one of those 'press the button and let the computer do it' games. This one struck out for me.

GRAPHiCS is truly extraordinary. Here we have a program written in such an exquisite way, so beautifully documented, that it is a great pity the author himself does not supervise its marketing. The cassette contains two programs, a machine language and a BASIC program. First on tape is the machine language program with a BASIC Goaddress. The disastrous result, if you simply read the cassette which says ›LOG, is a crash, so if you are away making a cuppa while loading you have a surprise waiting! For a program selling for over $20 one would hope that at least the fundamentals were correct. I know there are programs which sell for several hundreds of dollars and are still full of bugs, but I have never accepted that very happily either. Whatever happened to quality control in this industry?

Well, that feels better now. Nothing like a good whinge from time to time. Once having loaded the program, it was pure joy looking at the demonstration, which is all the program does. The demo lasts for a few minutes and consists of graphics on the whole screen. The program divides the screen into 11 520 dots and any one can be on or off. The most valuable part of the program, though, is all the REM statements, explaining exactly what is going on. It is very complex in internal operation but dead simple to follow. Again, parameters are passed via the USR function. Since plotting is done in machine language, it is very fast. This program is definitely recommended, since it uses the Sorcerer's graphics to its fullest potential. For those of you who have already purchased it, and presumably have the wrong Goaddress on tape, here is how to fix it:

Load the machine language part into the Sorcerer. Set the Goaddress to 0E78A and resave it. You will then be able to LOG it and the second one will automatically load as well. This goes for any other programs too. Simply key in LOG, though; don't use a name in case the second program has a different name.

Bye for now
A.P.F. Fry

Versatile EPROM programmer

MicroPro Design have announced the availability of a versatile EPROM programmer for use with the Commodore microcomputer.

The unit can program all currently available 1024, 2048 and 4096-byte EPROM integrated circuits, and menu-driven commands on the Commodore's screen give the ability to program, copy, read, display and modify an EPROM's contents.

Since all functional capabilities for the programmer are under control of a program executing in the Commodore microcomputer, the programmer module itself is simple and requires no controls. The programmer module simply connects to the parallel user port of the full range of Commodore computers.

For more information contact Andrew Mowat, MicroPro Design Pty Ltd, Suite 205, 6 Clarke St, Crows Nest NSW 2060. (02)438-1220.

Series 4500 to test micro-based systems

To provide organisations with a cost-effective test system for test program development, production go/no-go testing, repair and depot troubleshooting or fault isolation on microprocessor-based boards and systems, Millennium has introduced the new Series 4500 test station.

The Series 4500 is a universal tester which uses emulators to provide the flexibility to test functionally a broad range of microprocessor-based systems. Currently, emulators are available for the 6800, 6802, 8080A, 8085A, Z80A, 6801, 6803, 8021, 8041, 8048 8035, 8039 and 8748.

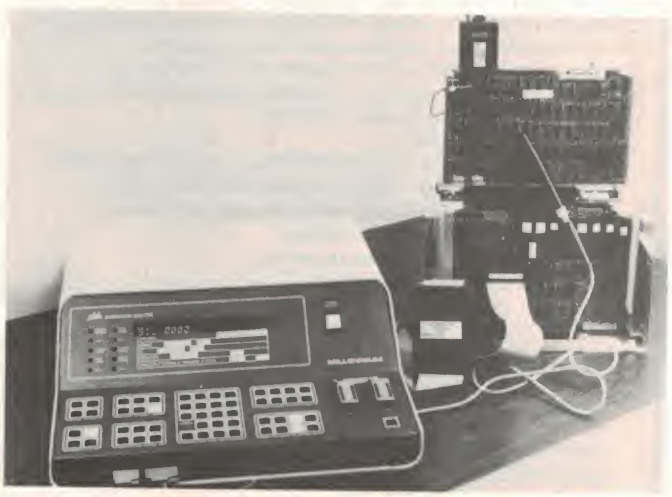
The 4500 test station incorporates three basic approaches to micro-system testing and trouble-shooting: time-domain analysis, in-circuit emulation and signature analysis. The test station provides results that can be read directly without requiring interpretation for rapid fault location, and may therefore be used by technicians with a minimum of training.

Utilising in-circuit emulation, the 4500 and plug-in emulator replace the system-under-test's own microprocessor to provide bit streams to stimulate the system. Signature analysis is used to sense and condense data streams throughout the system at every node. The condensed nodal data stream produces a bit pattern signature which is unique to every node being probed. In this way, the operator is able to trace correct and incorrect signatures to the failed component. The Series 4500 operates in real-time using the clock speed of the system's microprocessor.

With the Series 4500 test station, Millennium offers a five-day seminar/workshop to assist test engineers in developing functional testing and diagnostic software for their microprocessor-based products. During the courses attendees will learn techniques for logically partitioning systems, writing diagnostic software and methods of generating software stimulus to use signature and time-domain analysis for nodal level fault detection.

A wholly owned subsidiary of American Microsystems Inc. (AMI), Millennium offers a complete line of universal microprocessor support equipment for lab, test and field service applications.

For more information contact Warburton Franki Ltd, 372 Eastern Valley Way, Chatswood NSW 2067.



CAN YOU AFFORD NOT TO SUBSCRIBE TO MICRO-80?

MICRO-80 is a monthly magazine dedicated to users of SYSTEM 80 and TRS-80 microcomputers. Owned and produced entirely in Australia, each issue of MICRO-80 contains at least six programs, articles, useful hints and answers to readers' problems; all designed to help YOU get the most out of your SYSTEM 80 or TRS-80. Since MICRO-80's first issue in December 1979, we have published over 80 major pieces of software and 10 hardware projects. Most of the programs and articles are written by our readers to whom we pay publication fees thus enabling them to make their hobby pay. MICRO-80 readers can save money by buying Tandy products at 10% discount from an authorised dealer — for details see any issue of MICRO-80. Our sister business, MICRO-80 PRODUCTS, sells Australian designed and produced software and high quality, imported goods at low, sensible prices. We repeat, if you own a SYSTEM 80 or TRS-80,

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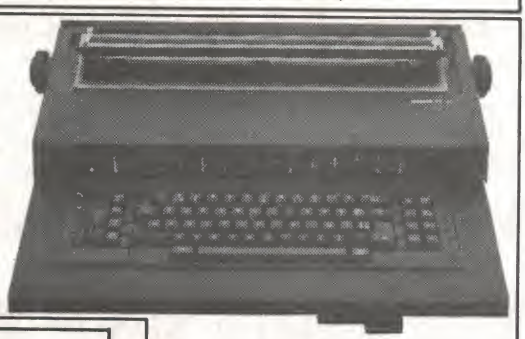
Daisy Wheel Typewriter/Printer

MICRO-80 has converted the new OLIVETTI ET-121 DAISY WHEEL typewriter to work with the TRS-80 and SYSTEM 80 or any other microcomputer with a Centronics parallel port (RS 232 serial interface available shortly). The ET-121 typewriter is renowned for its high quality, fast speed (17 c.p.s.), quietness and reliability. MICRO-80 is renowned for its knowledge of the TRS-80/SYSTEM 80 and its sensible pricing policy. Together, we have produced a dual-purpose machine:- an attractive, modern, correcting typewriter which doubles as a correspondence quality Daisy-wheel printer when used with your micro-computer.

How good is it? - This part of our advertisement was typeset using an ET-121 driven by a TRS-80. Write and ask for full details.



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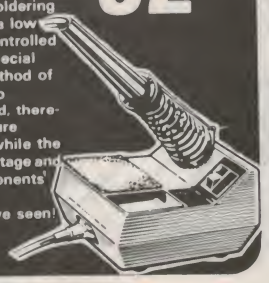
$62.50

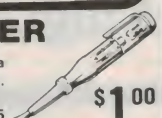
Transformer powered soldering station, complete with a low voltage, temperature controlled soldering pencil. The special Weller 'closed loop' method of controlling maximum tip temperature is employed, thereby protecting temperature sensitive components while the grounded tip protects voltage and current sensitive components' e.g. CMOS. Definitely the best we've seen!



Cat. T-1000

NEON TEST DRIVER

Ideal tool to carry in your pocket (it has a pen clip!) for testing the presence of AC. At this price, why take chances? Completely insulated. Cat. T-4005



$1.00

CABINET OF DRAWERS

This cabinet is ideal for small components, screws, nuts and bolts plus many other items. 16 drawer cabinet measures 300 x 180 x 140mm. Cat. H-2588

~~$17.50~~

$12.95

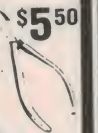
PLIKE

4 tools in one! Long nose plier, ⅜" cutter, built-in crimper, multisize wire stripper. A must for your toolbox! Cat. T-3165

$8.50

NIPPERS
$5.50

Transistor Nipper. Ideal for PC work. Cat. T-3200



Mini Diagonal Cutting Nipper. Drop forged steel construction.

$3.95 Cat. T-3561

DICK SMITH Electronics

NOW IS THE TIME TO BUY!

- AUBURN 648 0558
- BLAKEHURST 546 7744
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- BROOKVALE 93 0441
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- CHERMSIDE 59 6255
- ADELAIDE 212 1962
- MELBOURNE 67 9834
- RICHMOND 428 1614
- SPRINGVALE 547 0522
- PERTH 328 6944
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MAIL ORDER CENTRE: P.O. Box 321 North Ryde, NSW. 2113. Ph. (02) 888 3200

DSE/A007/LM

Electronics devotees will find DATA '81 a treat

Home computer equipment to handle everything from sex to tax will be on display at DATA '81, Australia's premier exhibition of computers and related information technology, to be held at Sydney's Centrepoint from August 25 to 27.

A HUGE ARRAY of equipment from both Australian and overseas manufacturers aimed at both commercial and home use will be on display. Enthusiasts will be able to view and discuss the most sophisticated systems and the simplest – and there will be no shortage of consultants both for software and hardware

One of the cheaper models on display for the home computer operator will be the System 80 series from Dick Smith.

The basic computer, which plugs into the home television set, costs $695 with 16K of main memory, and can be bought with extras such as disk drives, printers and extra memory. The System 80 series comes with a large series of programs designed for Australian conditions. According to Dick Smith spokesman Ross Tester, the 1981 income tax program has more information than the 1981 tax form. "It will tell you how much you will get back – or have to pay – something we understand the new form will not," he said.

Dick Smith also provide other useful and/or educational programs for their home computer. Locally designed programs, costing from $9 up, can teach you speed reading, typing, provide a flight simulator for trainee pilots, encourage reading and maths work in children through entertaining educational games, and help the businessman do his ledger work on the home computer.

But as well as the usual run of computer 'spaceship' games – plus others so interesting and complicated they can be played for weeks – this year's game programs include one called 'Interlude'.

"In this game the computer operates as the third partner in a 'menage a trois'," said Mr. Tester. "It asks intimate questions and from the replies either directly suggests an 'interlude' or refers the players to the manual. This program won't be on display at DATA '81 – it's for adults only."

The Tandy stand will also have displays for both the home user and businessman.

The basic computer for home use is the 16K version of the TRS80 model 3, costing $1399. This cassette-based computer can be used for accounting and record keeping, but also comes with the availability of more than 100 programs sold directly by Tandy, plus over 3000 available from outside programmers written for Tandy computers.

More ambitious home users can move up to the 32K version of the TRS80 model 3 for $3299.

Programs for these computers include mailing list, accounting, word processing, educational and games, although some require disk storage.

Also on display by Tandy will be a typewriter-quality daisy wheel printer.

Dick Smith and Tandy are but two of the many companies offering equipment to interest enthusiasts and businessmen. For those who want a computer but don't know which to choose, help is at hand.

On sale at DATA '81 will be the latest edition of the Computer Reference Guide's Australian Microcomputer Handbook. The handbook, at $23, will save the prospective computer buyer "countless hours of comparison", according to co-director Mr. Tony Webster.

"The new edition, which comes out in July, contains detailed information on what sort of computers are available, what software can be used and what additions are on the market. We also give details of price and local distribution, and each computer section has a three to four-page summary of its attributes and abilities.

"It took us a long time to prepare, so it would probably take the home buyer even longer to make the same comparisons. Furthermore, a browse through the handbook by the uninitiated could save a very costly mistake." ▶

LIST OF EXHIBITORS

Adler Business Machines Pty Ltd,
Cnr Lane Cove and Waterloo Roads,
North Ryde NSW 2113.
Tel: (02)887-7644

Stands 1, 2

Adler's display will cover its vast range of equipment designed for the electronic office, ranging from typewriters and calculators to sophisticated word processing and small business computer systems.

International Computers (Australia) Pty Ltd,
100 Arthur St,
North Sydney NSW 2060.
Tel: (02)929-0411.

Stands 3, 4

ICL, which offers on-line real time systems and commercial applications, will have a number of products on display.
ICL's packages include STARS, a sales and general accounting package with particular emphasis on order entry; SAFES, a production control system; and SPARES, a high-volume package for the spare parts industry with sophisticated re-ordering facilities.
ICL also provides specialised solutions for individual problems.

Cooley Douglas and Associates,
100 William St,
Kings Cross NSW 2010.
Tel: (02)357-3377

Stand 5

Cooley Douglas and Associates, established since 1969, is an independent software house and therefore prides itself on giving independent advice as regards the implementation of computer systems.
A team of consultants will be on hand at the stand to talk about systems development and other services.

Mitsui Computer Systems (Australasia) Pty Ltd,
7 West St,
North Sydney NSW 2060.
Tel: (02)929-9921

Stand 6

Overseas Telecommunications Commission (Australia),
32-36 Martin Place,
Sydney NSW 2000.
Tel: (02)230-5827

Stand 7

Adaps Ltd,
97 Pacific Highway,
North Sydney NSW 2060.
Tel: (02)929-4599

135 Inkerman St,
St. Kilda Vic. 3182.
Tel: (03)536-0141

Stands 8, 9

Adaps supplies software for mainframe and microcomputers and will be demonstrating software on microcomputers at DATA '81. It will also have information on hand about the McCormack and Dodge ranges of financial software for large mainframes.

Computer Supplies (Aust.) Pty Ltd,
54 Alexander St,
Crows Nest NSW 2065.
Tel: (02)439-5533

Stand 10

Dicker Data Projects Pty Ltd,
24 Woodfield Boulevarde,
Caringbah NSW 2229.
Tel: (02)524-5639

Stands 11, 12

Sord systems are marketed in Australia by Mitsui Computer Systems. This is the M200 Mark VI, which features a 4 MHz Z80A CPU, 64K RAM and 8K ROM.

Dick Smith Electronics Pty Ltd,
396 Lane Cove Road,
North Ryde NSW 2113.
Tel: (02)888-3200

Stands 13, 14

Dick Smith Electronics will be featuring the Exidy Sorcerer and Dick Smith System 80 computers. The Sorcerer is the only computer that converts to a word processor or assembly language development system by changing a simple plug-in 'ROM-PAC'. The System 80 is the latest and lowest-priced personal computer on the market. With prices beginning at under $700, it is the ideal computer for hobbyists or small-scale business use.
The computers on display will range from low-cost hobbyist set-ups to full-scale business systems capable of handling an entire business's accounting and word processing functions. A wide range of programs will be running on the computers – everything from sophisticated games to a complete accounting package for a small business.
As well as the computers, Dick Smith will display a wide range of calculators and other related products, plus an extensive collection of books on computers and computing. Trained Dick Smith staff will be on hand to answer questions and to demonstrate the equipment. All the equipment on display is available at Dick Smith stores around Australia.

Digital Electronics Pty Ltd,
31 Bridge St,
Pymble NSW 2073.
Tel: (02)449-4400

Stands 15, 16

Digital Electronics Pty Ltd is an Australian company which designs and produces computer systems and other microprocessor-based equipment. Its work covers a number of areas, including special research-oriented project work, data logging and process control and commercial systems.

DE recently received acclaim for its work with the CSIRO to produce a microprocessor-based system for automatically measuring the fineness of wool. The system, known as the Fibre Fineness Distribution Analyser (FFDA), uses a laser beam as part of the measuring process.

Hanimex Pty Ltd,
108 Old Pittwater Road,
Brookvale NSW 2100.
Tel: (02)938-0275

Stand 17

Hanimex is a long-established Australian importer of a wide range of products from cameras and microfilm to sporting equipment. At DATA '81 its office equipment division will be displaying Zilog and Sanders equipment, including the Zilog MCZ 1-05 microcomputer and Sanders Media 12-7 multi-font printer, as well as other equipment.
The division deals in micrographics, pagers, fax machines, computers, printers and copiers.

Computer Reference Guide,
Suite 204, 284 Victoria Ave,
Chatswood NSW 2067.
Tel: (02)411-2576

Stand 18

The Computer Reference Guide provides a number of publications relating to computer and associated industries in Australia. Three of these are 'up-date-able' subscription services with the following titles:
Minicomputers, Microcomputers and Peripherals
Word Processing
Data Communications and Terminals.
These services summarise and report on computer hardware, systems and application software associated with the above three areas. An additional publication entitled The Australian Microcomputer Handbook has proved to be a very popular low-cost publication for people in the small system area.
All the publications will be on display.

The Vector MZ, marketed by Dicker Data Services, is a powerful, versatile S-100-based system.

Keyboard Training,
6th Floor, 22 St. John Young Lane,
Woolloomooloo NSW 2011.
Tel: (02)357-1933

Stand 19

'KEYTRAINER', an audio visual training aid, which provides a number of ways to improve the performance of data entry operators, terminal operators, programmers, typesetters and word processors, will be exhibited.
Developed in the UK as a means of providing high-quality instruction when person-to-person training is not available, it can be used for initial training or as a permanent in-house means of providing a refresher course.
For the duration of the course an instructor remains on the client's premises and works with the client's operators on its equipment. Training also includes instruction in machine functions and programming.

Microsystems Pty Ltd,
140 Arthur St,
North Sydney NSW 2060.
Tel: (02)922-3494

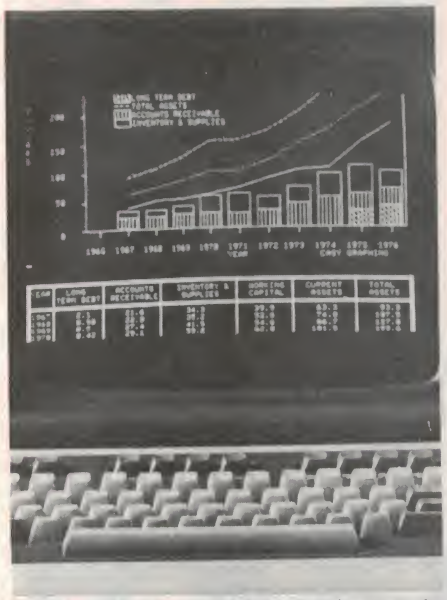
Stand 20

Microsystems is actively involved in micro publishing and microcomputers.
It specialises in filming commercial documents on to microfiche and has a computer output microfilm bureau at Parramatta, with the source document bureau located in North Sydney.
It also sells products such as microfilm readers and filing for microfiche.

Tektronix Australia Pty Ltd,
80 Waterloo Road,
North Ryde NSW 2113.
Tel: (02)888-7066

Stand 21

A world leader in computer graphics, Tektronix will be exhibiting a selection from its computer graphics products including high resolution graphics terminals, colour terminals, desk-top computer graphics, mini-computers and associated peripherals.
A special feature will be the recently released 4110 series of computer display terminals, which have set a new standard of speed associated with power in computer graphics. The 4110 series consists of the 4114, a 19-inch, high resolution, direct-view storage tube with refresh and fast local redraw capabilities; and the 4112, a moderate resolution 15-inch faster scan model featuring the high addressability of the storage tube.



Tektronix are the industry leaders in computer graphics. This display is typical of what you can get on their 4025.

Computer Tape Storage,
5 Nathan Lane,
Willoughby NSW 2068.
Tel: (02)958-1799

Stand 22

Calidad Magnetics Pty Ltd,
100 William St,
East Sydney NSW 2000.
Tel: (02)357-1355

Stand 59

Metropolitan Business College,
5th Floor, AMP Centre,
50 Bridge St,
Sydney NSW 2000.
Tel: (02)232-7666

Stand 24

Kenelec (Aust.) Pty Ltd,
48 Henderson Road, Clayton Vic. 3168.
Tel: (03)560-1011

Stand 25

Kenelec has had 19 years' experience in the supply and service of computer peripherals and scientific instruments in Australia. With offices in most states, it distributes a wide range of printers, VDU displays, flexible disk drives and paper tape punch and reader units.
At DATA '81 Kenelec will be displaying both new and well-established products including:
The R2E, a new and powerful Z80-based computer system made in France by the Honeywell-Bull organisation, with a major feature the availability of a 5¼-inch Winchester fixed disk drive with 5 Mbytes capacity.
The Teletype Model 43 printer with dual RS232 ports to allow connection of auxiliary equipment such as paper tape punch and readers.
Visual Technology VDUs with a selection of four screens.
The Data Royal '5000' series printer offering 80/132 column, bi-directional printing.
The IBM System 34 plug-compatible Decision Data serial printer model 6541-04 and the visual work station 3571-11.
The Remex single and double-sided eight-inch flexible disk drives with on-board controllers and provision for up to three slave drives. Also on display will be a range of Remex paper tape punch and reader peripherals.

Kwikasair Express,
30 Beaconsfield St,
Alexandria NSW 2015.
Tel: (02)698-0011

Stand 26

Kwikasair Express 'Computer Delivery', the official carrier for DATA '81, has a unique service in the transportation of computers and other delicate equipment.
Interstate vehicles are equipped with air ride suspension and are fully insulated to control temperature variation.
Electric stair crawlers, hydraulic tailgate trucks and two or three-man crews are used on all pick-ups and installations. All computer and other delicate units are wrapped in 'bubble plastic' for protection against dust and moisture.
Kwikasair offers express transit times nation-wide with overnight deliveries between adjoining eastern states, a next-day service between Sydney and Adelaide and a two-day service between Melbourne and Perth.
'Computer Delivery' also features an easy-to-calculate pricing formula based on weight and destination.

Tandy's latest — the TRS-80 Model III.

Tandy Corporation,
280-316 Victoria Road,
Rydalmere NSW 2116.
Tel: (02)638-6633.

Stand 27

Tandy will have microcomputer systems and related equipment on view, both for the businessman and the home user. The TRS-80 series has already proven poular among the latter.
The cassette-based computer can be used for accounting and record keeping, but also comes with the availability of more than 100 programs sold directly by Tandy plus over 3000 from outside programmers written for Tandy. The display will also include a typewriter quality daisy wheel printer along and many other elecronics products for which Tandy is famous.

Datael,
3rd Floor, 80 Chandos Street,
St Leonards, NSW 2065.
Tel: (02)439-4211.

Stand 28

Ibex Computers Australia Pty Ltd,
1st Floor, 127 York Street,
Sydney NSW 2000.
Tel: (02)29-6755.

Stand 29, 30

Ibex will be exhibiting a section of the range of micro-computers it manufactures, including the Ibex 7201 model which is used for medical and dental applications. Also on show will be the Datasouth DS 180 high speed dot matrix printer.

United Data Centres Pty Ltd,
127 Bowden Street,
Meadowbank, NSW 2114.
Tel: (02)807-3666.

Stand 31

Magnetic Media Services Pty Ltd,
5 Apollo Place,
Lane Cove NSW 2066.
Tel: (02)428-1100.

Stand 32

W. E. Hoskins,
PO Box 255,
Cronulla; NSW 2230.
Tel: (02)523-1002.

Stand 33

Wilson Bros (Printers) Pty Ltd,
28 Louis Street,
Chippendale NSW 2008.
Tel: (02)699-9933.

Stands 35, 36

In the world of personal computers there is just one that is known as the best: the PET

NOW 16K RAM AT 8K PRICE $999

The Commodore PET has become the standard for the Personal Computer Industry.

The Pet is completely integrated, with the processor, memory, keyboard and visual display unit contained within a robust housing, allowing easy transportation with no interconnecting cables necessary. In order to retrieve and save your data and programs, a storage device is used which operates like a cassette recorder, with your information recorded reliably on standard cassettes. The PET has 16k bytes of RAM. Optional equipment permits expansion to 32k. Also, it has 14k bytes of ROM.

The Pet communicates in BASIC— the easiest computer language. Easy to learn and easy to use, BASIC has now become the standard for personal computers, with literally thousands of programmes available. The PET is also programmable in machine language, allowing more efficient use of the system.

The full-size keyboard is capable of producing letters, numbers and graphic symbols. Upper and lower case is standard. Characters appear on the screen in a pleasant green colour designed to reduce eye fatigue and may be displayed in normal or reverse print.

PET's IEEE-488 Bus- just like H.P.'s mini and full size computers — permits direct connection to over 200 pieces of compatible equipment such as counters, timers, spectrum analysers, digital voltmeters and printer plotters from H.P., Philips, Fluke, Textronix and others.

The full range of Commodore Disk Drives and Printers are plug-compatible with the PET and a comprehensive range of cassette and disk based programmes are available through the extensive network of Commodore Dealers.

APPLICATIONS

The Commodore PET is a creature of many faces. Its applications are limited only by the user's imagination.

The future of the PET is virtually unlimited; its present capabilities are already many and impressive. As a personal computer, the PET can teach languages and mathematics; play games; create graphic designs; store meal recipes and change number of portions; maintain budgets, personal records and checkbooks; operate appliances and temperature controls.

As a management tool, it delivers the information the executive needs, in the form he can use, and available to him alone. Trend analyses charts and graphs can be almost instantly available.

The professional may use the PET for maintaining appointment schedules, recording income and expenditures and filing all the specialized information and forms he may need to make his work more efficient — from medical records for a doctor to income tax computations for an accountant.

The engineer, mathematician, physicist, has a tool far superior to the very best programmable calculators yet developed... at a cost that is comparable...and with almost infinitely greater versatility.

And the businessman has a computer that can maintain inventories, keep payroll records, operate accounts payable and receivables, issue cheques and handle correspondence.

Commodore PET 4016 Computer Technical Specifications.

Computer/Memory

Read/Write Memory (RAM) 16K bytes available to the user.
Read Only Memory (ROM) 14K bytes in total, divided into:
8K BASIC interpreter available immediately you turn on your PET.
5K Operating System
1K Test Routine
The 6502 micro-processor chip makes the PET one of the fastest and most flexible BASIC systems. Significant features of Commodore BASIC are:

- 960 simple variables
- 960 integers
- 960 string variables
- 960 multi-dimensional array fields for the above 3 types of variables
- Up to 80 characters per program line with several statements per line
- Upper/Lower case characters and graphics capability
- Built in clock
- 9-digit floating point binary arithmetic
- True random number generator
- Supports multiple languages; machine language accessibility

Keyboard

74-Key professional keyboard.
Separate calculator/numeric pad.
Upper-case alphabetical characters with shift key to give 64 graphics characters.
Can be set for lower case and shifted upper case characters.

Screen

40 characters wide by 25 lines (1000 characters in 8 × 8 dot matrix).
23 cm screen phosphor screen.
Brightness control.
64 ASCII plus 64 graphics characters.
Blinking cursor with full cursor control, including programmable control.

Screen editing capabilities

Full cursor control (up, down, left, right).
Character insert and delete.
Reverse character field.
Overstriking.
Return key sends the entire line to the CPU regardless of cursor position.

Input/Output

8 bit parallel input/output port.
IEEE-488 Bus (HP-IB and IEC Bus) allows up to 12 other peripherals to be connected.
Two cassette ports.
Video signals for additional displays.
Serial output port.

Technical Data

Dimensions:Height 355 mm (14"), Width 419 mm (16.5"), Depth 185 mm (18.5"), Shipping Weight 20.9 kg (46 lbs).
Power requirements 240V + 10%, Frequency 50 Hz, Power 100 Watts.

Commodore BASIC

APPEND	GOSUB..RETURN	STOP	SPC
BACKUP	IF..THEN	SYS	LEFT$
CLOSE	INPUT	VERIFY	RIGHT$
CLR	INPUT #	WAIT	MID$
CMD	LET		CHR$
COLLECT	LIST	SGN	ASC
CONCAT	LOAD	INT	LEN
CONT	NEW	ABS	VAL
COPY	ON..GOSUB	SQR	STR$
DATA	OPEN	SIN	TI
	POKE	COS	TI$
DEF/FN	PRWT	TAN	ST
DIM	READ	ATN	DS
DIRECTORY	RECORD	LOG	DS$
DLOAD	REM	EXP	+
DOPEN	RENAME	AND	−
DSAVE	RESTORE	OR	*
END	RUN	NOT	/
FOR/NEXT	SAVE	TAB	↑
GET	SCRATCH	POS	π

Commodore microcomputers

For details of your local dealer send to: Commodore Information Centre, Box 336, Artarmon, NSW 2064. Australia. Phone (02) 437 6296

MIvl 469

Anderson Digital Equipment Pty Ltd,
Unit 1, Pioneer Avenue,
Thornleigh NSW 2120.
Tel: (02)848-8533.

Stands 37, 38

Anderson Digital Equipment will be emphasising two areas at DATA '81. The terminals group will be showing models of the newly acquired Centronics printer range up to the 600-lines-a-minute line printer and other data terminals.
The systems group will display the North Star microcomputer system and ADE business microcomputer systems with supporting terminals, storage and memory devices to suit these and other major minicomputer suppliers.

Moore Paragon Australia Ltd,
The Boulevard,
Richmond Vic. 3121
Tel: (03)429-3411.

Stand 39, 40

Moore Paragon is Australia's largest business forms manufacturer and is closely linked to the application of computers through its wide range of products and services.

American Micro Systems Pty Ltd,
275 Alfred Street,
North Sydney NSW 2060.
Tel: (02)922-3099.

Stand 41

American Micro Systems will be unveiling a number of software and hardware packages new to the Australian market covering market research, the short term money market, bill of materials, financial modelling, word processing and data communications and data base.
Each of these has been developed in Australia through co-operation with the respective industries. AMS claims to be the largest seller in Australia of commercial microsystems.

John G. Stevenson & Co Pty Ltd,
221 O'Riordan Street,
Mascot NSW 2020.
Tel: (02)669-6033.

Stand 42

Australia's largest locally-owned freight forwarders and customs agents, John G. Stevenson, will have a special display featuring FACS (facilitated air clearance service) equipment which enables importers to reduce significantly the time it takes to air freight goods from the US.
The stand will be manned by John G. Stevenson's staff and by Ms Karen Guide, a US expert in the transportation of computer equipment.

The Computer Resources Company Pty Ltd,
32 Huntley Street,
Alexandria NSW 2015.
Tel: (02)516-4099.

Stands 43, 44

Computer Resources has updated and extended its complete range of computer room furniture, tape and storage systems and mobile terminal tables.
All this will be amply displayed along with a new 26-page computer supplies product guide.

AM Jacquard,
204 Botany Road,'
Alexandria NSW 2015.
Tel: (02)699-8555.

Stand 45, 46

AM Jacquard will display its J500 standalone word processing system, its J100 shared logic system and OCR and will demonstrate its latest software.

Anderson Digital Equipment base their systems and software around the acclaimed Northstar micro.

Amalgamated Wireless (A/Asia) Pty Ltd,
132 Arthur Street,
North Sydney, NSW 2060.
Tel: (02)922-3300.

Stand 47

AWA will be demonstrating the Micromax small business computer system as part of its commitment to small business, an indication of which is a 12-months full parts and labour warranty on Micromax.
AWA boasts that within all State capital cities, it can supply service at the user's site within four hours of a fault being reported. Outside the metropolitan areas, a cross-over replacement unit is despatched as quickly as possible.
The Micromax is a versatile microcomputer sold through a network of authorised dealers around Australia, all of whom have been selected for their ability to serve the needs of the first-time computer user.
Micromax has as a key feature the STARDOS multi-user operating system, enabling it to handle several tasks at the same time. It also offers a wide and varied range of software applications.

Commercial Computer Centre Pty Ltd,
10 Pitt Street,
Parramatta NSW 2150.
Tel: (02)635-4544.

Stand 48

Commercial Computer Centre claims to be the largest data entry organisation in Australia, operating with five divisions. Among the products on display will be Syncom magnetic media.

Hartley Computer,
39 Sherwood Road,
Toowong QLD 4066.
Tel: (07)371-5444, (02)816-1155.

Stands 49, 50

Hartley is best known for developing the public accountants' package HAPAS and general accounting package SHEILA. It will be demonstrating both on its successful 3900 series computer.

M.S.C.O. Computer Sales,
Suite 6, Willunga Place,
3 Old Castle Hill Road,
Castle Hill NSW 2154.
Tel: (02)680-2161.

Stand 53

M.S.C.O. is a Cromemco dealer specialising in application software, mainly for public accounting. Its systems range from a public accountants system to small to medium sized commercial systems.
It will be displaying the Flexicount package for public accountants and a complete manufacturing package. Flexicount is a highly flexible accounting and management system allowing for a single user or up to seven users. M.S.C.O. will be releasing new products at DATA covering manufacturing, multi-user debtors, creditors and stock control packages and a number of smaller specialised taxation packages.

Memorex Pty Ltd,
61 Barry Street,
Neutral Bay NSW 2069.
Tel: (02)908-2211.

Stands 54, 55

Memorex, a leading supplier of IBM compatible communications equipment and computer media, plans to have a comprehensive display, including the Memorex 2076 communications controller, the 2087 printer and 2078 VDU. There will also be a dynamic display hooked up to a system in the company's office in Neutral Bay.

Racal Electronics Pty Ltd,
47 Talavera Road,
North Ryde NSW 2113.
Tel: (02)887-3666.

Stand 56

Established in Australia almost 20 years ago, Racal Electronics is part of the rapidly expanding Racal Group of Companies.
With vast experience in data communications Racal prides itself on providing a comprehensive service to both first-time users and industry "giants".
Equipment includes time division multiplexers, modems, modem sharing devices, frequency division multiplexing, statistical multiplexing, network management and diagnostic systems, line drivers, lineplexers, patching equipment, data link monitors and testers. ▶

Sigma Data Corporation Australasia Pty Ltd,
157 Walker Street,
North Sydney NSW 2060.
Tel: (02)922-3100.

Stand 57, 58

Sigma Data distributes Datapoint data processing and communications management systems, Wordplex word processing, Applied Digital Data Systems (ADDS) peripherals and terminals, Centronics printers and Maxell computer supplies.
Among its many products on display will be the new Series 80 word processors.

Liveware Pty Ltd,
19 Boundary Street,
Rushcutters Bay Sydney 2011.
Tel: (02)33-4268.

Stand 60

Wilke Business Forms Pty Ltd,
41-45 Lorraine Street, Peakhurst NSW 2210.
Tel: (02)53-0771.

Stand 61

Wilke Business Forms, in conjunction with its associated companies, has production facilities in four States and sales offices in every Australian State.
It manufactures a wide range of continuous stationery, business forms and multisets for the computer industry. In addition it also markets the "UARCO" range of forms handling equipment. The range includes bursters and deleavers for both mini-users and larger mainframe establishments.
Among equipment on display will be the new table top Model 2202 deleaver.

O'Reilly Computer Pty Ltd,
6 Ryde Road,
Hunters Hill NSW 2110.
Tel: (02)896-2799.

Stand 83

O'Reilly Computer (formerly GM O'Reilly & Associates) is best known for developing the highly successful financial and management accounting package FAMAS. O'Reilly Computer have added DOCGEN, a word processing package, CHEMPAC, a chemical formulae bill of materials package and a real estate package.
These and one or two others still under wraps will be demonstrated on the powerful Japanese ABC series of microcomputers which O'Reilly is marketing under licence.

Omni Office Furniture Systems,
23 Monro Avenue,
Kirrawee, NSW 2232.
Tel: (02)521-8333.

Stand 66

The Omni Office display will demonstrate the potential of well designed modular furniture to provide for a happier VDU work environment.
Omni believes too little thought has been given to the ergonomic and productive needs of VDU operators and associate staffing, including analysts, programmers and professionals.
Omni Office furniture is a free-standing system of linked panels onto which are hooked desks, storage modules, pinboards, drawers, whiteboards, lamps and power outlets, etc. Staff can easily re-arrange the layouts after hours, to keep pace with changing needs.
Omni Office will be releasing a fully adjustable VDU work station incorporating an L-shaped desk and fully adjustable seating. All necessary media is stored within convenient reach of the operator and ducting for power, signal and Telecom lines is built in.
Task lights and ambient lighting are designed into the system to minimise eye strain and power consumption. Special adjustable stands are also available for printers and the Omni Cabinet has interchangeable modules for storing and displaying disc packs, floppy discs, microfiche, aperture cards, tape seals and cassettes.

Syfar Pty Ltd,
Box 2154,
GPO Sydney NSW 2001.
Tel: (02)922-7222.

Stand 67

Syfar is a North Sydney software house specialising in providing solutions for a variety of individual problems. It provides solutions covering such areas as real estate management and manufacturing and production control.
It is also a dealer of AWA's Micromax, an integrated business package.

The Computer Company Pty Ltd,
4 Cliff Street,
Milsons Point Sydney NSW 2061.
Tel: (02)436-1733.

Stands 68, 69

The Computer Company will be exhibiting its recently-released comprehensive computer system which includes hardware, software and training with a price tag of less than $10 000.
The price puts the system, based on the Panasonic 740 computer, into the bracket once occupied by hobbyist computers, yet offers a full range of business applications. The model 740 is one of the Panasonic family of microprocessor based computers for which TCC is sole Australian distributor.
The package includes well-proven applications software for order entry, invoicing, accounts receivable, accounts payable, stock control and sales analysis.

Graphic Directions Pty Ltd,
8th Level, 28-36 Foveaux Street,
Surry Hills NSW 2137.
Tel: (02)212-4199.

Stand 70

Creative designers and exhibition promoters, Graphic Directions, which is responsible for DATA, will have its own stand to show its annual reports and printing section.

Caringbah Sheet Metal (Aust) Pty Ltd,
42 Cawarra Road,
Caringbah NSW 2229.
Tel: (02)524-0791.

Stand 71, 72

Caringbah Sheet Metal will display a full range of EDP storage systems, which it has specialised in developing over a number of years.

Datacraft Pty Ltd,
Cnr Lincoln and Croydon Roads,
Croydon Vic. 3136.
Tel: (03)725-5477.

Stand 73

Fliway Computer Transport,
Cnr William and Banksia Streets,
Botany NSW 2019.
Tel: (02)666-4700.

Stand 74

Fliway Computer Transport offers total transport and installation services to all areas of the electronics industry. With 18 years' experience, it has built a reputation as a leader in the handling and transportation of high value equipment throughout Australia and New Zealand.
The company services interstate haulage, metropolitan installation, storage and staging rooms and site inspections and supervisions of installations at any location within Australia.

Control Data (Aust) Pty Ltd,
508 St Kilda Road,
Melbourne Vic. 3004.
Tel: (03)51-0351.

Stand 75, 77

Control Data Australia offers software targeted at specific industries and areas, including education, mining and petroleum, government, weather and environment, electric utilities, banking and finance, engineering and manufacturing.

Sola Basic Australia Ltd,
109 Alexander Street,
Crows Nest, NSW 2065.
Tel: (02)439-1503.

Stand 78

McGraw Hill International Training Services,
PO Box 253,
Forestville NSW 2087.
Tel: (02)406-4288.

Stand 79

McGraw Hill International Training Services is an international division of McGraw Hill incorporated in the US and has combined a number of products to aid the data processing and business systems markets.
One of the better known of these is the Datapro range of directory services which have been used in Australia for many years by the data processing community. Other products to be on display will be the Edutronics range of data processing training course materials, the Tratec range of marketing and sales training programs, the Medsy Reports on hospital and pathology computer systems, and related books of interest to the industry.

J. Saunders & Sons Pty Ltd,
62-64 McLachlan Avenue,
Rushcutters Bay NSW 2011.
Tel: (02)357-6661.

Stand 80

Saunders is a company specialising in raised printing and will be promoting the business card side of its operations with an attractive display and a "lucky draw" prize of $500. The winner will be drawn on the last day of DATA '81 from the collection of business cards that visitors will have pinned to a special display board in the Saunders stand, with the result appearing in the Sydney Morning Herald of September 2.
The display will also show raised printed letterheads, both loose and mounted for word processors.

IBM Australia Ltd,
100 Walker Street,
North Sydney 2060.
Tel: (02)923-5829.

Stand 81, 82

At time of writing IBM was not too prepared to reveal what was to be displayed.

M.I.M.S.,
Suite 5, 1st Floor,
163 Commercial Road,
Prahran Vic. 3000.
Tel: (03)241-6571.

Stand 84, 85

Pacific Computer Weekly,
73 Commonwealth Street, Sydney NSW 2000.
Tel: (02)212-2077, (03)51-8431.

Stand 86

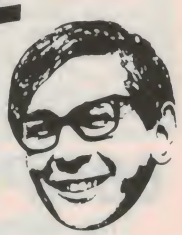
The Australian,
2 Holt Street,
Surry Hills Sydney NSW 2000.
Tel: (02)2-0924.

Stand 93

See article in this months E.A.
KIT AVAILABLE THIS MONTH

UNBELIEVABLE!

THIS MUST BE AUSTRALIA'S BEST VALUE COMPUTER!



- Full size keyboard
- Video modulator
- 9K Super Basic
- 16K RAM
- Cassette Interface
- S-100 Expandable

THE EA/DICK SMITH SUPER 80

Are you fed up with 'built up' projects? – why not build this professional quality computer & save over 50% on equivalent built units!

A FULL SIZE 16K COMPUTER KIT

You are supplied with a full board including power-on EPROM monitor, 16K of RAM, cassette interface (relay activated) for universal control of any tape recorder, TV modulator and direct video output PLUS full size professional keyboard

Above photo shows some parts which are optional — not supplied in basic kit

PROFESSIONAL QUALITY KEYBOARD

ALL THIS FOR ONLY $289.50
SHORT FORM KIT
Cat. K-3600
P&P $5.50

DON'T PAY OVER $600 FOR A BUILT UP 16K COMPUTER WITH BASIC!

THE FANTASTIC SUPER 80

EXTRAS

Transformer	M-2325	$22.50
BASIC interpreter on tape	K-3602	$24.50
IC socket set (Recommended)	K-3603	$12.50

Yes, this would make the full computer with 9K BASIC & 16K RAM

ONLY $349.00

THAT'S $50 LESS than our advertised price 12 months ago!

Supplied with re-print of EA article.
- Combined large Assembly and Technical manual $12.50 B-3600
- 'Super' Basic Reference Manual $14.50 B-3602

DICK SMITH ELECTRONICS

VISA

See our other advertisements in this publication for store addresses, phone numbers, post and packing etc.

935M/AH

APPLE AND NORTHSTAR COMPUTER BUYERS

APPLE AND NORTHSTAR COMPUTER OWNERS

COME TO COMPUTER COUNTRY

AT COMPUTER COUNTRY — We have always believed our customers are entitled to quick delivery and total and comprehensive after-sales service and advice. We have based our whole business on providing quick and efficient delivery and professional after-sales support. So if you are thinking of purchasing a microcomputer system or adding to the one you already have, make a good investment — invest in a little bit of time to talk to the professionals at Computer Country. Remember the quality of the after-sales hardware service and continual after-sales software and hardware advice you get is just as important as the price of the system you buy. Come and have a chat with the professionals of Computer Country just once and you'll realise how much help we can be in enabling you to get the most out of your microcomputer system.

Computer Country stocks a wide range of microcomputer hardware including the Apple, Northstar, Commodore, Texas instruments, NEC, Impact data and many more. We carry a wide range of software for many systems including the TRS-80. We can also help you in customising software for your specific application.

Our service department not only completely backs up all hardware purchased from us, but invites enquiries from those who have purchased elsewhere and have hard-to-fix problems.

Make a Smart Move — Come to

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COMPUTER CITY

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- *Enquire now about our National Adventure Tournament.*

COMING SOON

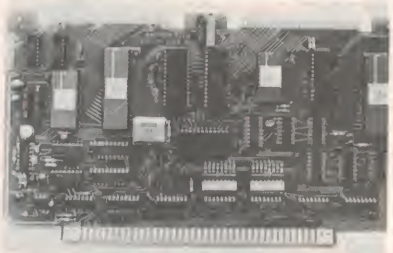
68PDC04

Processor and Disc Controller Card.

- Accepts Motorola 6802 and 6809 microprocessors
- Single 2716 (+5V) or 2732 EPROM for each microprocessor
- 1k scratchpad RAM
- Extended addressing range
- Software/Hardware trace facility
- Full RS232 with handshaking
- Parallel port with control lines
- Single density/Double density, 5 inch/8 inch, single sided/double sided Floppy Disc Controller interface

68GPB03

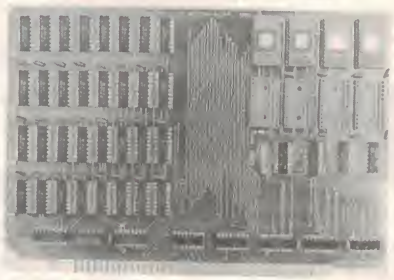
The ultimate in microprocessor I/O.



- 16 channel ADC (with 12 bit resolution).
- 2 channel DAC (with 8 bit resolution).
- 32 bit programmable I/O (2 x MC6821).
- 6 programmable timers (2 x MC6840).
- 2 serial synchronous/asynchronous interfaces.
- Hardware and software programmed baud rate generation.
- High quality double-sided PCB.
- Motorola Excorciser Bus and outline compatible.
- Occupies only 32 consecutive bytes.

68MB02

Two boards in one



- 16K RAM (2114) expandable in 1K increments.
- 16K EPROM (2716, plus 5V) expandable in 2K increments.
- Two 8K RAM blocks selectable in 8K increments.
- Two 8K EPROM blocks selectable in 8K increments.
- High quality double-sided PCB.
- Motorola Excorciser Bus compatible.

MICRO GEAR

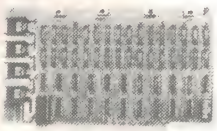
3 Coora Place, Churchill, VIC. 3842

Phone (051) 67-1498 A.H. (051) 22-1157

SME SYSTEMS

STOCK CLEARANCE SALE

16K STATIC RAM

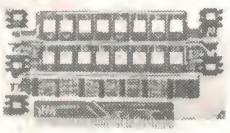


2114 low power RAM chips, 4K addressable boundary, standard bank select (40H), 4MHz operation with no wait state required when using our chips, wait state generator for above 4MHz, plated thru holes, solder resist, optional 300nS RAMS available.

KIT $250 **A&T $290**

BARE PCB $45

2708 16K EPROM



Switch selectable as 8 or 16K card, 8K address boundary, wait state generator, suits industry standard, 2708's standard S100, plated thru holes, solder resist.

KIT $85 **A&T $98**

BARE PCB $45

SD MPB-100 Z80 CPU

KIT $250 **A&T $280**

NEW PRODUCT

$599 PRINTER

80 COL. DOT MATRIX TRACTOR FEED, CENTRONICS INTERFACE, 80 CPS, BI-DIRECTIONAL GRAPHICS. ASK FOR DATA SHEET

THESE PRICES VALID UNTIL CURRENT STOCK RUNS OUT

22 Queens Street, Mitcham, Vic. 3132. PO Box 19, Doncaster East, 3109. Telex AA37213. PHONE (03) 874-3666

Send 66c in stamps for COMPUTER PRINTOUT CATALOGUE for more details

ALL PRODUCTS AUSTRALIAN MADE AND EX STOCK (ALMOST) DEALER ENQUIRIES WELCOME

Prices and specs subject to change without notice

All prices tax free. for retail prices add 15 percent.

NEW!

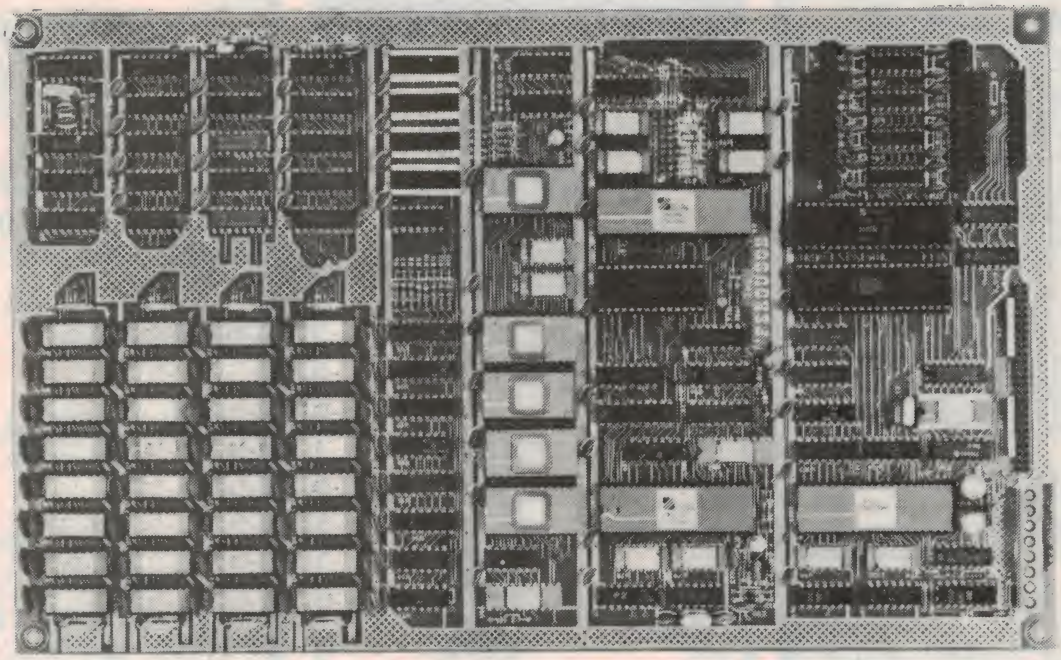
"THE BIG BOARD"

OEM - INDUSTRIAL - BUSINESS - SCIENTIFIC

SINGLE BOARD COMPUTER KIT!

Z-80 CPU! 64K RAM!

NEW!



THE FERGUSON PROJECT: Three years in the works, and maybe too good to be true. A tribute to hard headed no compromise, high performance, American engineering! The Big Board gives you all the most needed computing features on one board at a very reasonable cost. The Big Board was designed from scratch to run the latest version of CP/M*. Just imagine all the off-the-shelf software that can be run on the Big Board without any modifications needed! Take a Big Board, add a couple of 8 inch disc drives, power supply, and an enclosure, and you have a total Business System for about 1/3 the cost you might expect to pay.

$695.00 (64K KIT BASIC I/0)

SIZE 8½ x 13¾ IN
SAME AS AN 8 IN. DRIVE
REQUIRES 5V @ 3 AMPS
12V @ 5 AMPS

FEATURES: (Remember, all this on one board!)

64K RAM

Uses industry standard 4116 RAM'S. All 64K is available to the user, our VIDEO and EPROM sections do not make holes in system RAM. Also, very special care was taken in the RAM array PC layout to eliminate potential noise and glitches.

Z-80 CPU

Running at 2.5 MHZ. Handles all 4116 RAM refresh and supports Mode 2 INTERUPTS. Fully buffered and runs 8080 software.

SERIAL I/O (OPTIONAL)

Full 2 channels using the Z80 SIO and the SMC 8116 Baud Rate Generator. FULL RS232! For synchronous or asynchronous communication. In synchronous mode, the clocks can be transmitted or received by a modem. Both channels can be set up for either data-communication or data-terminals. Supports mode 2 Int. Price for all parts and connectors: $95

BASIC I/O

Consists of a separate parallel port (Z80 PIO) for use with an ASCII encoded keyboard for input. Output would be on the 80 x 24 Video Display.

24 x 80 CHARACTER VIDEO

With a crisp, flicker-free display that looks extremely sharp even on small monitors. Hardware scroll and full cursor control. Composite video or split video and sync. Character set is supplied on a 2716 style ROM, making customized fonts easy. Sync pulses can be any desired length or polarity. Video may be inverted or true.

FLOPPY DISC CONTROLLER

Uses WD1771 controller chip with a TTL Data Separator for enhanced reliability. IBM 3740 compatible. Supports up to four 8 inch disc drives. Directly compatible with standard Shugart drives such as the SA800 or SA801. Drives can be configured for remote AC off-on. Runs CP/M* 2.2.

FOUR PORT PARALLEL I/O (OPTIONAL)

Uses Z-80 PIO. Full 16 bits, fully buffered, bi-directional. User selectable hand shake polarity. Set of all parts and connectors for parallel I/O $45

REAL TIME CLOCK (OPTIONAL)

Uses Z-80 CTC. Can be configured as a Counter on Real Time Clock. Set of all parts: $25

PFM 3.0 2K SYSTEM MONITOR

The real power of the Big Board lies in its PFM 3.0 on board monitor. PFM commands include: Dump Memory, Boot CP/M*, Copy, Examine, Fill Memory, Test Memory, Go To, Read and Write I/O Ports, Disc Read (Drive, Track, Sector), and Search. PFM occupies one of the four 2716 EPROM locations provided. It does not occupy any of the 64K of system RAM!

CP/M* 2.2 FOR BIG BOARD

The popular CP/M* D.O.S. modified by MICRONIX SYSTEMS to run on Big Board is available for $150.00.

TERMS CASH CHEQUE OR BANKCARD (MIN $100 DEP)

ALL PRICES PLUS TAX IF APP

REGISTERED PACK & POST $5.00

RITRONICS WHOLESALE

425 High Street, Northcote, VIC.
Phone (03) 481-1923, 489-7099.
PO Box 235. Telex AA 38897.

Copy of manual and assembly instructions $15. Refundable on purchase of board. Photocopy exchanged for original. Delivery ex stock.

Bankcard Mail Orders Welcome

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Bankcard No .....

Expiry Date .....

Name .....

Signature .....

ETI 8/81

Computer 'back-up' supply

E. Williams

ONE OF the problems of running a microcomputer without auto-battery back-up is that, if the mains fails (usually after entering a long program), you lose the lot and have to re-enter it from the start. It only takes the 5 V supply to disappear for a few milliseconds for the damage to be done.

After being caught once (and once was enough), I designed the supply shown here.

A switch-on the full-wave rectifier (D1-4) supplies regulator IC1, which gives 5 V after steering diode D7. D5 raises the output of IC1 to compensate for the drop across D7. Diode D6 raises the output of IC2 to compensate for D8.

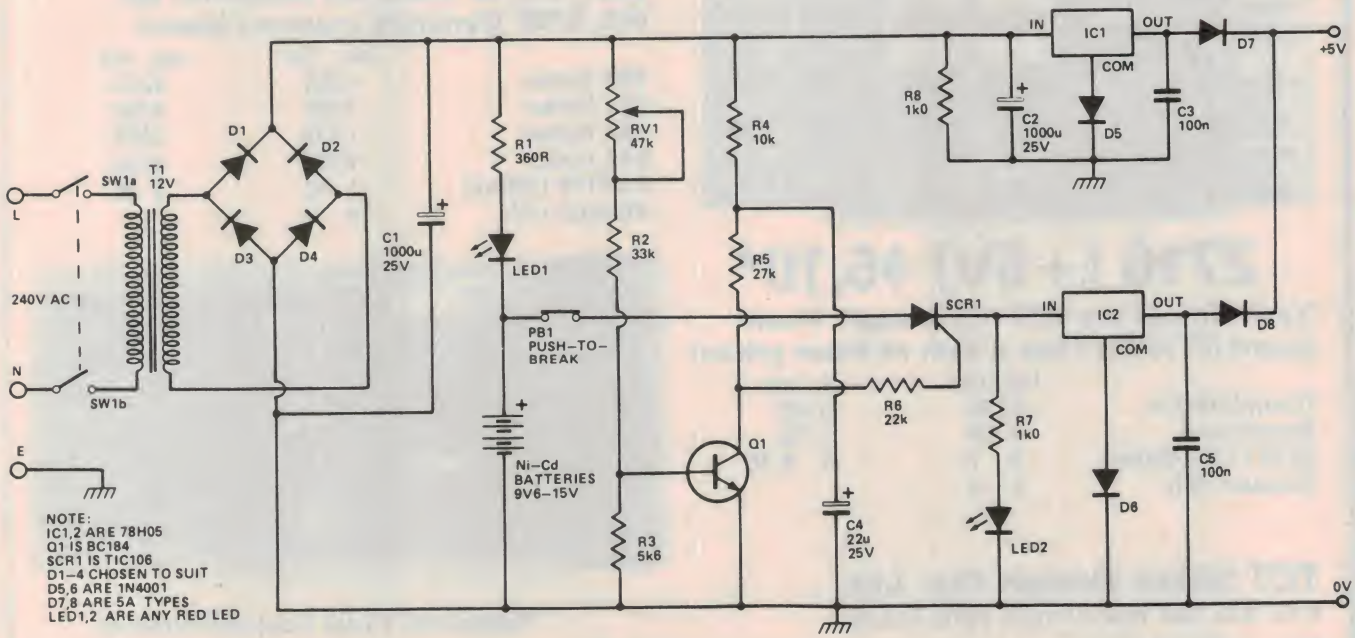
The collector of Q1 is normally held low, initially by C4 and R5 while C1 and C2 are charging to the full supply potential, and then by base bias network RV1, R2, R3. The low at Q1 collector holds SCR1 off via R6. The Ni-Cad batteries are trickle-charged by R1-LED1; LED1 lights up to indicate that the batteries are charging and becomes reverse biased to prevent battery discharge when the unit is switched off.

If the mains fails or is switched off, either by accident or on purpose, the current flowing into Q1 base via RV1 and R2 decreases to zero. Long before the supply to IC1 has become too low to maintain the 5 V rail, Q1 will have turned off and fired SCR1. This allows the batteries to supply IC2, a second regulator which takes over from IC1 before the microcomputer supply is interrupted. LED2 is turned on via R7 to give an indication that the batteries are being discharged.

If the mains should now come back on, LED1 will again light to indicate mains presence, but LED2 stays on until the reset button is pressed to switch off SCR1.

When you wish to switch the unit off, first switch off the mains and then press the reset button to turn off SCR1. In this condition there is no drain from the batteries so the unit can be left for weeks without detrimental effect. Ni-Cads of 4 Ah rating were used to give a 9.6 V supply. Two units have been built and both have proved 100% reliable.

If a supply of less than 1 A is required, 7805 regulators can be used and D7, D8 can be replaced by 1 A devices. The transformer and rectifier diodes should be rated in accordance with the current required. RV1 should be set to middle position and then adjusted for best operation. If battery voltages greater than 9.6 V are used, R7 must be increased in value and R1 decreased. The transformer, bridge rectifier, IC1 and C1-3 may be available in your original supply, in which case it will only be necessary to modify it to the circuit shown in the diagram. ●



A look at the Anadex DP-9500 printer

Next to the CRT terminal, the second most popular input/output device is a printer. Elaine Ray looked at the Anadex DP-9500 printer for us, and found it a reliable and versatile machine, with particularly good graphics capability.

Elaine M. Ray

A COMPUTER is of very little use without a good quality hard-copy device, and with a huge range of makes and models to choose from it often becomes a bewildering task for users to choose the printer that is best suited to their specific application.

Changes in technology over the last twelve months have caused the price of printers to fall considerably, while at the same time there has been a rise in the quality and reliability of models offered.

A large number of printers offered for use with microcomputers do not have keyboards and cannot be used for entering data into the computer. Most models offered have a number of switch selectable and communication selectable features that give the end user a wide range of printing and formatting options.

In view of the large numbers of different brands and models available ETI was delighted when Bell and Howell offered their Anadex Model DP-9500 alphanumeric line printer for review. With no effort it was up and running, being completely plug compatible with the Vector Graphics VIP

(see June '81 issue) that was used to put the printer through its paces, and the two combined to make a very compact and efficient unit for the small business user.

Anadex Inc. of Chatsworth, California, is a high technology company manufacturing products for the industrial instrumentation and computer peripheral market. Bell and Howell is the Australian and South East Asian distributor for Anadex and is represented by offices in all Australian capitals along with New Zealand, and a growing number of O.E.M. distributors.

The Model DP-9500 is a 96-character ASCII alphanumeric dot matrix line printer designed for all printing applications including those requiring high-density graphics. The standard printer contains a 600-character buffer of true First In First Out storage. An additional plug-in 2K buffer is available for applications requiring increased buffer storage such as CRT dump. Data can be accepted continuously or in bursts.

Pricing places this model in the mid-range of printers offered and it is certainly well worth the asking price of $1850 (excluding sales tax).

Print features

In reviewing a printer it is very difficult to look at anything other than its printing capabilities and features and the best way to go about this is to present the printer with a variety of print formats, graphics and document pagination requirements. Using a number of documents and the various switch and communications commands the Anadex behaved very well indeed.

Three dot matrix print densities are available:

- 10 characters per inch (cpi), printing at a rate of 150 characters per second (cps) with a 9 x 9 dot matrix format.
- 12 cpi, printing at a rate of 180 cps with a 7 x 9 dot matrix format.
- 13.3 cpi, printing at the rate of 200 cps in a 7 x 9 dot matrix format.

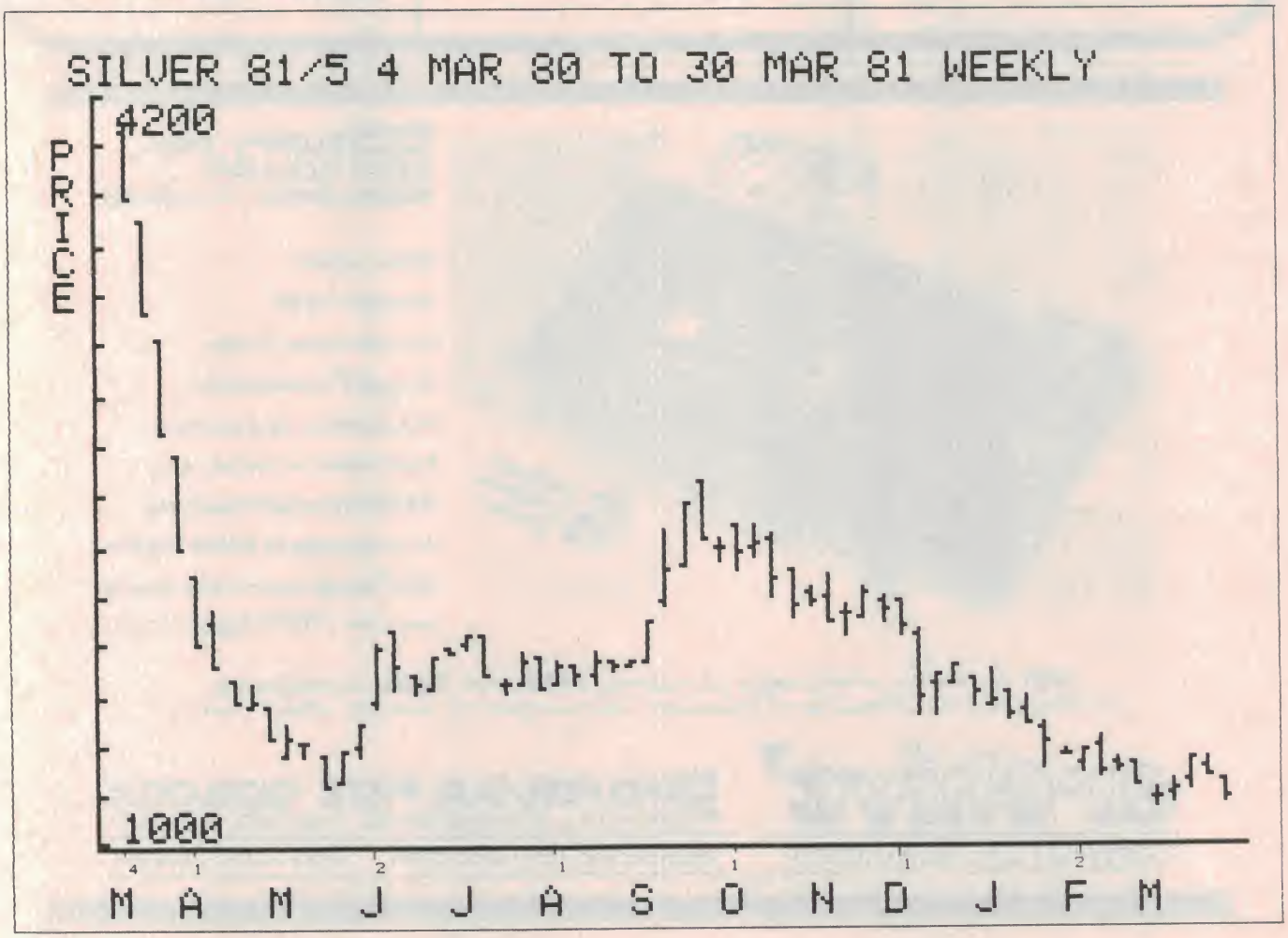
The 10 and 13.3 cpi printing densities are both switch selectable and communications selectable. The 12 cpi print density can be selected by communications command only. All three densities can be printed double width by communications command. Character fonts are selectable by switch or communications control.

We noted the 132, 158 and 176 character width columns can be set and printed using the printer's nine-wire print head. The heavy duty print head is claimed to have an average life expectancy of 350 million characters. Printing is bidirectional with 'shortest distance' sensing logic. Up to eight horizontal and 15 vertical 'tab set' or 'cleared' formatting is available using communications controls.

Forms control and line feed

The Anadex offered easy to use and very efficient forms control and line feed. The stepper-motor-driven incremental paper movement was smooth and never faltered. Vertical spacing is offered at six or eight lines per inch, communications and switch selectable. Manual control of vertical registration is possible in 1.4 mm (0.056 inch) increments. Additionally, front panel switches allow bidirectional registration in 0.36 mm (0.014 inch) increments. Forms length is initially established in 13 mm increments by ▶

This graph illustrates the sort of character construction and graphical capabilities possible on the DP-9500.



The Superboard Ready to go, ready for more

Cassette interface, 300 Baud Kansas City standard, so you can swap programs, ask your dealer how to double the speed!

Printer port and sound generation.

All you need is a 5v power supply.

RF Modulator Connection.

24 x 24 or 12 x 48 Display

4MHz crystal

4K of RAM on-board space for a further 4K ready socketed. Just plug in the chips.

Character generators giving a full 256 characters from Alpha-numerics to planes, guns and spaceships.

6502 processor or chip as in four out of five of the top selling personal computers.

Monitor ROM, allowing you to enter machine code.

Your connection to the expansion facilities, up to 32K or RAM, dual disks and the outside world.

8K BASIC available on power up with floating point, trig functions, multi-dimensioned array, and full string facilities.

Full 53 keyboard with upper case, lower case and graphic elements. Drive it in polled mode and you can detect up to eight keys pressed simultaneously — how's *that* for real-time games?

Joystick interface. It gives a 'natural' feel to game manoevres like driving a tank, firing a rocket.

Our Superboard lets you suit yourself, offering a ready to go configuration that you can add to as needed. The Superboard is the first complete personal computer system contained entirely on a single board.

This is a major electronic breakthrough and we at Ohio Scientific accomplished it by using custom state-of-the-art LSI micro circuits. The Superboard offers you more features than many of the more expensive alternatives.

We designed the Superboard specifically with versatility and economy in mind. It is suitable not only for the serious computer user, but also for first time users, the student or the hobbyist. The Superboard gets you off to the right start, and you can add to it later – saving money all along the line. If you're just starting, get the ready-to-go CI model, then all you'll need is your cassette and television set and you're into the world of computers in a really serious and flexible way.

EXPANSION CAPABILITIES:
— UP TO 32K MEMORY
— DUAL MINI-FLOPPY DRIVES
— FULL COLOUR VIDEO
— PROTOTYPING BOARDS
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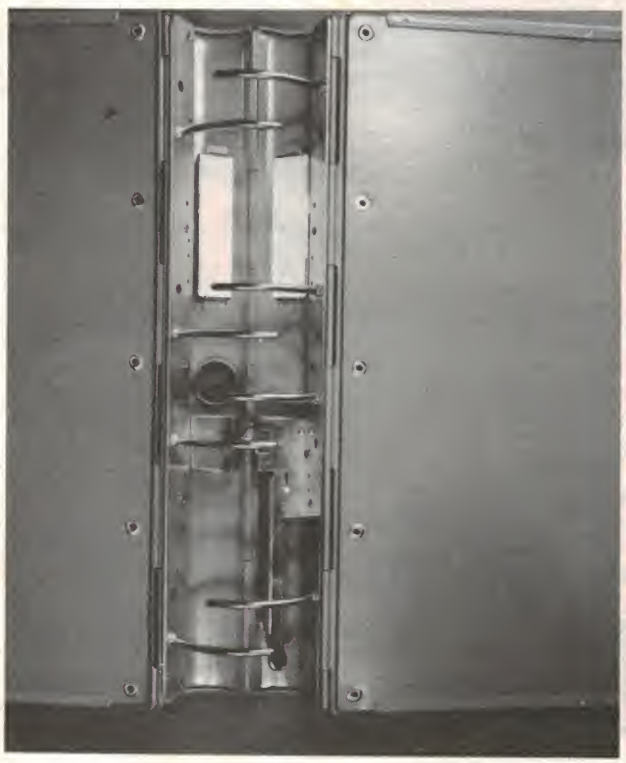
SPECIAL OFFER!! — direct from ETI



HERE IS A MOST UNUSUAL SPECIAL OFFER.

Our company has for sale 1500 of the most superbly made binders you've ever seen in your life!

We bought them for a data service which has since closed down. They are specifically intended to hold data sheets and similar material which must be referred to constantly. All those for sale are brand spanking new — but we can show you some old ones that have been in constant hourly use for over 20 years and they are still as new!

We know this sounds like hyperbole, but these devices can only be described by using superlatives. They're made (like a Rolls-Royce!) by the Swedish company Aggripa.

For example, the hinge assemblies are made of heavy-gauge plated steel. The spine and all outer edges of the covers are heavy-gauge enamelled steel. Apart from the steel hinges holding the covers, the spine itself is hinged down the centre, enabling the binder to lie completely flat for easy insertion and removal of material.

As may be seen from the pix, material is held in place by an eight-hole pin mechanism — actuated by a remote control trigger at the bottom of the spine. They hold paper measuring approximately 230 mm x 300 mm, and will take a stack about 45 mm thick.

These binders are ideal for housing valued reference material, data sheets, etc, etc.

These binders are not normally obtainable in small numbers — if they were the retail price would be at least $25 each.

We are offering them *exclusively* to ETI readers for the absolute bargain price of $10 each (plus $2.00 post and packing). See also inset table for quantity prices.

These binders may be inspected at our Sydney and Melbourne offices during normal working hours.

UNCONDITIONAL MONEY-BACK GUARANTEE.

ETI guarantees to return the purchase price in full and without query to any reader/s not totally satisfied with their purchase, providing the goods are undamaged and returned within seven days of receipt.

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switch setting and modified by communications control in single line increments to 255 lines. This allows for quality printing of large, specialised documents.

By adjusting the tractor positioning, forms widths can be set from 1.75 to 15.6 inches (44.5 to 396 mm). Printable line width is communications controllable from 1.0 to 13.2 inches (25.4 to 335 mm) in 0.1 inch (2.5 mm) increments. The skip-over perforation is established initially by switch selection. However, it can also be modified by communications control, giving great printing flexability.

Automatic line feed is both switch and communications selectable to provide an automatic line feed after a CR code, which will terminate printable data only upon receipt of an LF, VT or FF code. The switch selectable truncate/wrap-around mode is useful to allow either truncating lines containing more characters than the selected Form Width and Character Width Font allow, or print the excess characters on the next line. Forms feed is commanded from communications or the front panel switch.

An original document may be printed with up to five copies. Paper loading is very easy and alignment no problem.

Graphics

True high density graphics are available under direct control of the data source. The resolution of 72 dots per inch vertical (about 28 per cm) and 60 dots per inch horizontal (about 24 per cm) is excellent for most graphics requirements. Dots may be printed in groups of up to six vertical dots simultaneously across the page on a per line basis. The paper can be advanced unidirectionally in 0 to 9 increment steps per instruction byte. By printing a six-dot vertical group and stepping six increments, a continual vertical line is printed.

Graphic dots are transmitted in seven-bit bytes, six of which directionally control the six print needle solenoids normally used in printing graphics. These graphics bytes are transmitted on a single line basis by transmission of a control code at the beginning of each line of graphics data. If alpha characters are to be printed in the graphics mode, the data source must map the characters, or the line must be overprinted on the next pass of the printhead.

Communications

Three ASCII-compatible interfaces are standard with the Model DP-9500:

- Serial ASCII, RS-232-C interface, which accepts Serial ASCII asynchronous input data. The printer may be programmed to function at any of the standard rates between 50 and 9600 bits per second. Data rate is switch selectable. Input character codes of either seven or eight-bit words are accommodated. A handshake signal indicates when the internal buffer storage can accept data.
- Serial ASCII, Current Input — this interface can accept serial ASCII asynchronous input data at rates from 50 to 4800 bits per second. The interface is compatible with either the 20 mA or 60 mA current loop required by Teletype printers.
- Parallel Bit, Serial Character Synchronous. This interface accepts input data in parallel bit, serial character form at a closed loop rate in excess of 1000 characters per second. Data bits are accepted on receipt of an internally generated strobe signal. Internally generated ACKNOWLEDGE and BUSY signals indicate the minimum time interval between strobe signals and when the internal buffer storage is full. Two alternative signals are available, INPUT BUSY and BUFFER EMPTY, for those applications having a single handshake signal capability. Input data and all interface control signals are Centronics-compatible.

Communications control includes the following features:

- DEC protocol simulation.
- STX/ETX:full point-to-point communications capability is available and is switch selectable. In this mode, data preceded by ASCII code STX is accepted but not printed. Upon receipt of the ASCII code ETX, the printer responds to the data source with an ASCII ACK or NAK code. If the data was unsatisfactory, the code is NAK, the data block is cancelled and the data source can retransmit the data. If the code was ACK, the data source can transmit either ASCII code EOT or STX and the data will be printed. By switch-selection the ETX may be followed by an LRCC character.
- CAN: receipt of the ASCII CAN code causes any unterminated data to be cancelled.

Conclusion

The Anadex DP-9500 is a sophisticated and reliable quality dot matrix printer suitable for a number of different applications. Its graphics capability is particularly impressive. Any small businessman looking for a printer would be well advised to consider the Anadex closely. ●

'SUPER INVASION' PROGRAM TO WIN FOR YOUR ZX80 COMPUTER!

20 PROGRAM CASSETTES FOR 20 WINNERS!

(can also be run on the MicroAce)

Melbourne House (Australia) Pty Ltd, who are supplying software for the Sinclair ZX80 in Australia, recently released a Super Invasion program cassette for ZX80 enthusiasts. This enables you to play a version of the popular 'space' games where you have a 'ship' on screen under your control which can be knocked out by a group of invader ships. You can fire missiles from your ship to knock out the invaders, meanwhile dodging their barrage by moving your ship left and right across the screen.

To promote the newly released Super Invasion games cassette, Melbourne House (Australia) have offered 20 cassettes as prizes for this contest to go to twenty winners. The cassette normally costs around $20.

Here's your chance to win one of these Super Invasion games cassettes so you too can play one of the most popular computer games on your ZX80 or MicroAce. Just complete the entry form and send it in.

This contest is jointly sponsored by ETI and Melbourne House (Australia) Pty Ltd — who have generously donated the prizes. Melbourne House are the publishers of '30 programs for the Sinclair ZX80:1K', reviewed in Printout in the March 1981 issue of ETI.

The Super Invasion program has the following features: • flicker-free display • three levels of play in each game • moving graphics — no hardware modifications required, just load the cassette and off you go! • available for standard or 8K ROM machines (tick box on entry form to indicate which ROM you have) • each cassette has 2K version on other side featuring automatic reset which will challenge you for hours!

You may enter as many times as you wish but you must use a separate entry form for each entry and include the month and page number cut from the bottom right hand portion of this page. You must put your name and address on the entry form and sign it where indicated.

Please read the contest rules carefully, especially if sending multiple entries.

RULES

This contest is open to all persons normally resident in Australia with the exception of members of the staff of Melbourne House (Australia) Pty Ltd, Modern Magazines (Holdings) Ltd, K.G.Murray Ltd, Australian Consolidated Press, Offset Alpine Pty Ltd and/or associated companies.

Entries should be addressed to ETI/Super Invasion Contest, Electronics Today Int., 15 Boundary St, Rushcutters Bay, NSW 2011.

Closing date for the contest is 30 September 1981. Entries received within seven days of that date will be accepted if postmarked prior to and including 30 September 1981.

The winning entries will be judged by the Editor of ETI, whose decision will be final. No correspondence can be entered into regarding the decision.

Winners will be advised by telegram the same day the result is declared. The names of the winners, together with the winning answers, will be published in the next possible issue of ETI.

Contestants must enter their name and address where indicated on each entry form. Photostats or clearly written copies will be accepted but if sending copies you must cut out and include with each entry the month and page number from bottom of the page of the contest. In other words you can send in multiple entries but you will need extra copies of the magazine so that you send an original page number in each entry.

This contest is invalid in States where local laws prohibit entries.

Entrants must sign the declaration accompanying this contest that they have read the above rules and agree to abide by their conditions.

ENTRY FORM

• Name three games for the ZX80 included in '30 Programs for the Sinclair ZX80:1K' published by Melbourne House.

.....

• Tell us in 50 words or less why you would like to play Super Invasion on your ZX80 (or MicroAce).

.....

.....

.....

.....

.....

.....

.....

.....

.....

I have ☐ a standard ROM
☐ an 8K ROM (tick appropriate box)

Name .....

Address .....

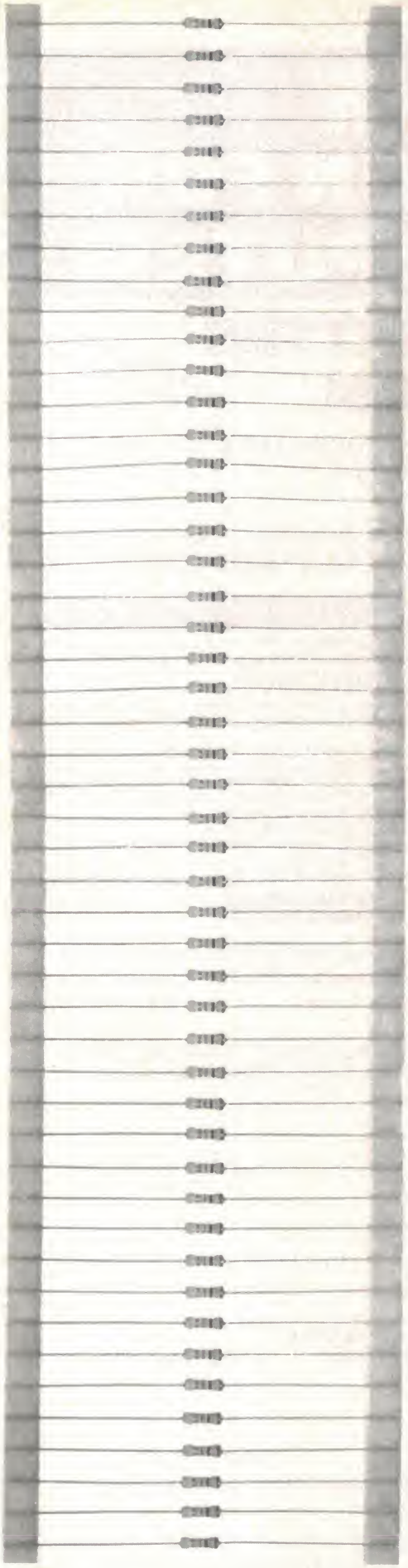
.....

..... **Postcode** .....

I have read the rules of the contest and agree to abide by them

Signed .....

Date .....



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AHEARN EL 42

ZX80 NIM

J. McCartney

Beats 'Matchsticks' any day of the week!

WHILST THIS GAME makes no claims for its originality, it does illustrate just how much you can expect to cram into the ZX80's 1K of RAM. This version of NIM displays three rows of markers, each of which contains a random number of elements from two to seven. You can take any number of elements from any row in your turn but whoever removes the last element loses.

Fitting it in

The program just fits into the 1K of RAM; the listing does show through in some cases but at least it doesn't crash. If you are in proud possession of the extension memory units or the new 16K module then you can probably improve the commenting and instructions.

To play the program once loaded, simply key RUN and NEWLINE. The program will prompt for the number of elements you wish to remove (line 130) and from which row (row 160); each of these should be followed by NEWLINE. The game is programmed never to produce identical rows (in line 90) and will also check to ensure that it never gives you a winning combination to start with; the subroutine at 400 checks for this.

All entries are validated, so an attempt at cheating will lose you the game. Because you have the first move you should be able to win every time. Five consecutive wins gives you the match.

Strategies

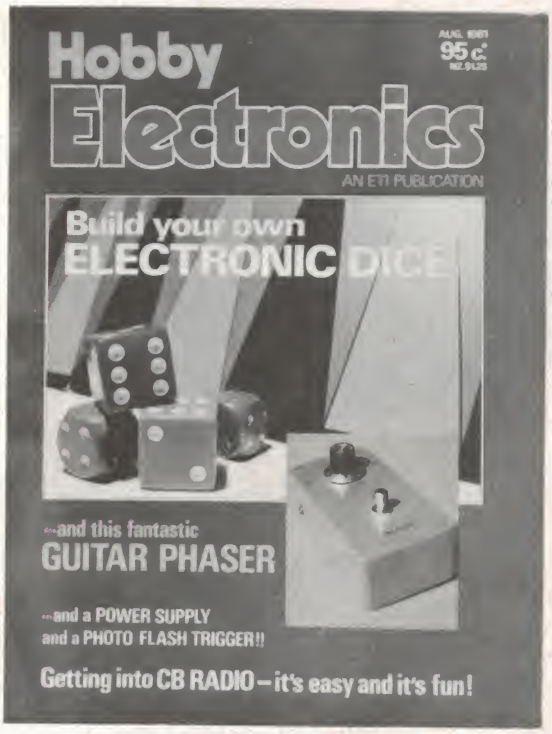
The game routine is contained in the subroutine at 400, so if you like you can work it out. It is worth remembering the ZX80 only works with integers.

The scoreboard is produced by lines 430 to 490 and the screen display is produced in the routine from line 500. The graphics character is in the standard code; i.e: it's the graphic on the 'Q' key.●

Program Listing

```
10   CLEAR
20   LET B=0
30   LET C=0
40   PRINT "NEW MATCH"
50   DIM A(2)
60   FOR J=0 TO 2
70   LET A(J)=RND(6)+1
80   NEXT J
90   IF A(0)=A(1) OR A(1)=A(2) OR A(0)=A(2) THEN GOTO 60
100  GOSUB 400
110  IF J=4 THEN GOTO 60
120  GOSUB 500
130  PRINT "YOUR TURN. HOW MANY?"
140  INPUT Y
150  PRINT
160  PRINT "WHICH SET?"
170  INPUT X
180  CLS
190  IF X<1 OR X>3 OR Y<1 THEN GOTO 430
200  LET A(X-1)=A(X-1)-Y
210  IF A(X-1)<0 THEN GOTO 430
220  IF A(0)+A(1)+A(2)=0 THEN GOTO 440
230  GOSUB 500
240  PRINT "MY TURN. KEY 0,NEWLINE."
250  INPUT Q
260  CLS
270  FOR H=1 TO 7
280  FOR J=0 TO 2
290  LET A(J)=A(J)-H
300  IF A(J)<0 THEN GOTO 350
310  IF Q=1 THEN GOTO 120
320  GOSUB 400
330  IF J=4 THEN GOTO 120
340  IF M=0 THEN GOTO 460
350  LET A(J)=A(J)+H
360  NEXT J
370  NEXT H
380  LET Q=1
390  GOTO 270
400  LET M=A(0)+A(1)+A(2)+(A(0)/2+A(1)/2+A(2)/2)*8
     +(A(0)/4+A(1)/4+A(2)/4)*80
410  IF M=222 OR M=220 OR M=202 OR M=200 OR M=22 0 R
     M=20 OR M=3 OR M=1 THEN LET J=4
420  RETURN
430  PRINT "CHEAT"
440  LET B=B+1
450  GOTO 470
460  LET C=C+1
470  PRINT "SCORE: ZX80 ";B;" PLAYER ";C
480  IF B=5 OR C=5 THEN GOTO 10
490  GOTO 50
500  PRINT
510  FOR J=0 TO 2
520  PRINT J+1
530  IF A(J)=0 THEN GOTO 570
540  FOR H=1 TO A(J)
550  PRINT " Q";
560  NEXT H
570  PRINT
580  PRINT
590  NEXT J
600  RETURN
```

Take it easy



If you like electronics but you sometimes find you're a bit out of your depth in ETI, we've got good news for you. There's a new electronics magazine called **Hobby Electronics** that makes things a lot easier.

Hobby Electronics is specially designed for easy reading. That doesn't mean we use extra big print and treat you like an imbecile — it just means that we explain everything you might not already know.

Every month **Hobby Electronics** has complete, detailed instructions for building several projects, as well as fascinating features on all aspects of electronics. And because it's published by the same people as ETI, you can be sure that everything has been done properly — all the projects have been tried and tested, all the features double and triple-checked for accuracy and authenticity.

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Hobby Electronics
AN ETI PUBLICATION

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Sight & Sound

The bilateral turntable arrives

Sharp's new design in record players allows music lovers to play both sides of their favourite record without having to turn it over — a development that could effectively make every other turntable now on the market seem like obsolete equipment.

Designated the VZ-3000, the home stereo set built around the new design was unveiled at the Museum of Applied Arts and Sciences in Sydney, where the Museum director, Dr. Lindsay Sharp, accepted the first set released in Australia for the Museum's collection.

The bilateral player is already being produced as part of a compact home stereo system that includes cassette tape and radio components. The complete unit will sell for less than $1000 — reflecting Sharp's determination to make the most advanced equipment available to everyone.

The bilateral design is based on a simple concept made practical through microcomputer technology.

Instead of being in a horizontal position, the new record player is housed in a slim, vertical console. The front of the console opens and the record is placed in vertically, then the microelectronics take over.

Once the door is closed the in-built computer automatically centres the record, recognises its size, and sets the playing speed. Using two linear tracking tonearms (one on each side of the record), the new player allows continuous play of both sides of any size record, random play of either side and endless repeat of one or both sides, all via soft-touch controls and without the need to handle the record.

To repeat one side, a 'repeat' button is pushed, and to repeat both sides in sequence, the repeat button and 'dual play' buttons are pushed. No matter which way the record is programmed, one can switch sides immediately at the touch of a button. To momentarily interrupt play, a touch of a cue control lifts the tonearm from the groove.

Either of the linear tracking arms can be moved from one track to another, and the system includes a host of safety factors that make it impossible to damage the record surface once the turntable door is closed.

Apart from the bilateral turntable, the VZ-3000 also features an AM/FM stereo tuner, Dolby cassette with Auto Programme Search System, 25 watt channel amplifier and matching speakers.

Club for video owners

A 'club' to assist video recorder owners and buyers to get the most from their equipment with the minimum hassle has been set up by Video Tape Network of Melbourne.

Video Tape Network offers a catalogue with a selection of all pre-recorded video tapes presently available in Australia, a wide range of exclusive new titles from overseas, a large variety of accessories not generally available in Australia, and a special members' purchase price on items like large-screen TVs, personal computers and portable video cameras.

Members receive a regular update of the catalogue and a newsletter, and can use a special search service to help them locate a particular video tape or tapes in a particular interest area.

One year's membership normally costs $20, but at present Video Tape Network is offering membership plus a package of tape tracker indexes for only $10.

Contact G. Alpert on (03)329-7998 for further information.

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sight & sound news

New Quad electrostatics — finally!

We note from advertisements appearing in the June issues of various British hi-fi and technical publications that Quad have at last put an end to the rumour and speculation that have swept the industry for the past year, and released their new electrostatic speakers.

Called the ESL-63, the speakers are described as a "... full range electrostatic double ...". Here's what Quad claim:

"The Quad ESL-63 has a very light plastic diaphragm positioned between two sets of acoustically transparent concentric annular electrodes. Signal is fed to the electrodes sequentially via a delay line. The resultant sound pressure pattern is a facsimile of that which would be produced by an ideal point source positioned some 30 cm behind the plane of the diaphragm; completely phase true, very aperiodic, with a level response and near perfect directivity index devoid of all side lobes.

"The result with a good programme source is a stereo picture of an acoustic event which we believe to be significantly superior to anything previously available."

Some claim! We'll believe it when we hear it. How soon for us, Quad?

Videotape accessories from Bib

A range of maintenance accessories for VHS and Beta format VCRs is now offered by Bib, who are well known for their audio tape maintenance accessories.

The Bib VE-2 Video Recorder Maintenance kit includes: • five special video tape head cleaning tools • tape head cleaning fluid • a can of patented 'dust-away' air blast • an inspection mirror • anti-static cleaning cloth • an illustrated maintenance manual. Bib advise that this kit is for simple, routine maintenance and claim its use will prevent and reduce undue wear on the critical tape contact points.

Bib also have cleaning tape cassettes for both VHS and Beta machines. The VE-11 (VHS) and VE-12 (Beta) tape cassettes work by inserting the cassette and playing it for about 15 seconds to clean the heads. Bib claim each cassette has sufficient tape included to provide 20 cleaning operations.

For more information on these and other Bib video tape maintenance products, contact Bib Hi-Fi Australia, 43 Birmingham St, Alexandria NSW 2014. (02) 667-2750.

A for Andromeda

Peterson Speaker Laboratories were established in 1974, and have since made a good name for themselves as leading Australian manufacturers in the domestic and semi-professional hi-fi markets.

In their new premises in Clayton South, Peterson not only manufacture and assemble the speakers, but also the enclosures and centre console cabinets. Design engineer Bob Peters and the staff have also developed the Andromeda series of professional hi-fi speakers.

Aware of the competition from imported brands, Peterson set out to make a top range of speakers that was at the same time inexpensive in terms of value for money and aesthetically attractive. They claim to have achieved this with the Andromeda series.

Andromeda I costs around $750 rrp and comprises a 30 cm (12") driver with matching mid-range and tweeter, both the latter being attenuated on the front panel. Standing 79 cm high x 39 cm wide x 39 cm deep, the speakers have timber joints and a removable glass top, and the whole is a finely tuned reflex system. This is a 100 W RMS unit.

Andromeda II is similarly styled but 100 cm high, with two mid-ranges and twin ports. It is also a tuned reflex system giving 150 W RMS and sells for around $1000 rrp.

Andromeda III is a dual 25 cm (10") driver, dual reflexed six-element speaker, 120 cm high and of a squared timber structure. It givews 200 W RMS and sells at around $1400 rrp.

The Rolls Royce of the series is the subwoofer system, which is four speakers in all in two 100 cm enclosures, to be placed at the rear or the side of the room. Peterson claim that listening to this system is "nothing short of an auditory experience", and describe its effect as "dramatic". Rrp for this system is $2000.

All the Andromeda series have been designed and developed over six years, keeping in mind the new generation of dc amps, digital recordings and modern compandor techniques.

For further information contact Peterson Speaker Laboratories, 11 Fury Court, Clayton South Vic. 3189.

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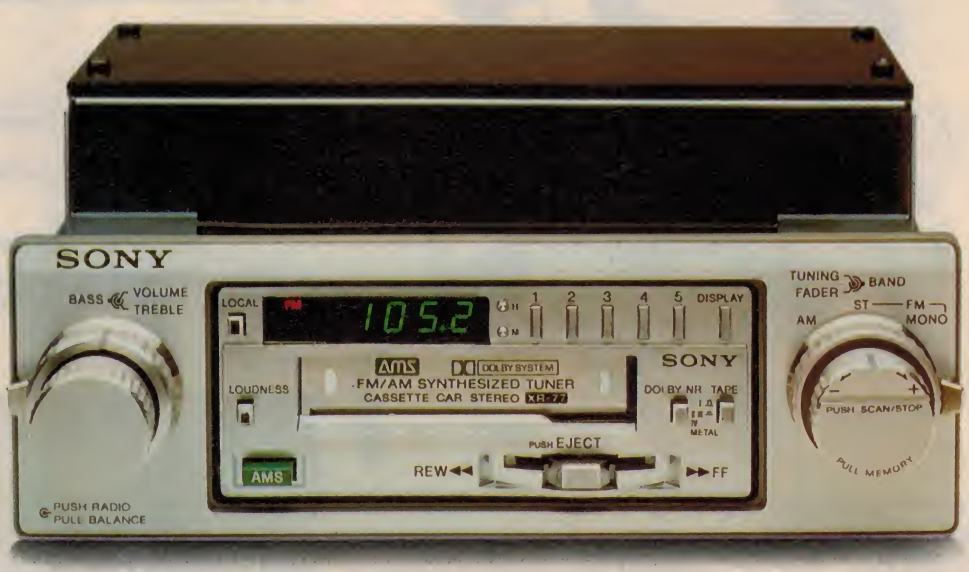

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BONE FONE

SPECIAL OFFER — EXCLUSIVE TO READERS OF ETI

CONVOY INTERNATIONAL PTY LTD were recently appointed sole Australian distributors for the **BONE FONE** — an AM/FM stereo receiver that you wear like a scarf — and they have agreed to make a number available at a special price to ETI readers to promote the unit as it has only just been released here.

Recommended retail price: normally $79.95

SPECIAL OFFER PRICE:

$49.95!

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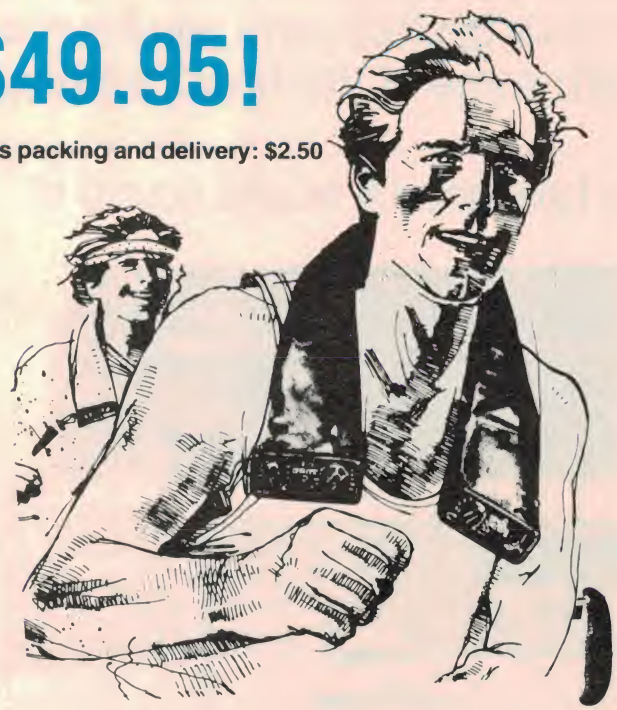

The **BONE FONE** is an AM/FM stereo receiver constructed so that you can wear it like a scarf. The integral speakers provide stereo sound that the manufacturer claims is heard, or rather experienced, through your body by 'bone conduction'. The **BONE FONE**, unlike headphones or earpieces, does not block out external sounds. If you're active in any sport — jogging, ski-ing, cycling, horse riding, skating, etc — the unit can be secured by straps that permit free body movement. You can wear the **BONE FONE** whilst working, gardening or mowing the lawn — or just relaxing. The **BONE FONE** is powered by four penlight batteries. The sleeves may be changed (various colours available); a blue lycra spandex sleeve is supplied with these units.

The unit is warranted by Convoy International for 90 days after purchase and is supplied with a bone-shaped storage bag, straps, warranty card and instruction booklet.

OFFER CLOSES 30 SEPTEMBER

NOTE: This offer is made by Convoy International Pty Ltd and ETI is acting as a clearing house for orders only. Cheques or money orders should be made out to Bone Fone Offer and sent to:

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We will then process the order and pass it on to Convoy, who will send you the goods. Please allow up to four weeks for delivery. Offer expires 30 September.

Please supply ..... Bone Fone(s)
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(Please allow up to four weeks for delivery).

SIGHT & SOUND news

Electronics Show for Perth

The 1981 Perth Consumer Electronics Show is to be held over 3 to 6 September at the Ascot Racecourse, a new venue this year.

Last year's show was a roaring success and this year's show promises to better it, according to pre-show publicity.

The show will be housed on three floors at the Ascot Racecourse buildings, covering some 2000 square metres of floor space. Admission charges have been set at $1 per adult, children under 14 free. The Perth Sunday Times and Channel 9 are major sponsors.

If you're swanning around Perth in September, don't forget the third to the sixth, at the Ascot Racecourse.

Cheapest video colour yet?

Hitachi's recently introduced video colour camera, the VKC750, is claimed to be the cheapest colour camera available today, and is intended to appeal to both the newcomer to video and to the enthusiast.

The VKC750 employs a tri-electrode single pick-up tube, which minimises bulk and weight. This tube uses separate electrodes for each of the three primary colours, and is claimed to produce just as high quality pictures as would be expected from a more expensive professional camera.

The VKC750 weighs about 8.5 kg and is no larger than a conventional 8 mm cine camera; this compactness is made possible by extensive use of ICs. Battery drain is only 5.8 W.

The built-in double-image optical viewfinder is linked to a 2.8:1 zoom lens with a focal length of 13.5 mm to 37.5 mm. If the images are lined up in the viewfinder, perfectly focused pictures should always be obtained. A colour temperature control button is also fitted to operate in conjunction with a balance meter to ensure correct colour tone reproduction under varying light conditions.

A letter 'V' in the viewfinder indicates that recordings are being made; 'L' shows that there is insufficient light for optimum results; 'B' lets you know that the battery is low. A special ASC circuit automatically adjusts the sensitivity so that filming under an extremely wide range of light intensity (from 100 to 100 000 lux) is possible.

A built-in microphone is provided, with provision for the addition of an external mic.

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Rare: very valuable.
Addi'tions: the things added.
Mar'antz: a range of ultra-high performance Slimline and three-quarter size Amplifiers which blend state-of-the-art engineering with operational versatility.

Although all units in a hi-fi system must be compatible in order to achieve optimum sound quality, there is no question that their final standard of performance relates directly to the main amplifier. It is the heart of the system and the point at which distortion is most likely to be introduced.

Marantz engineers have developed special techniques for reducing the various forms of distortion to miniscule levels. This is achieved by the use of a highly efficient negative feedback system and operation in class AB, with the careful selection of "shortest path" wiring to avoid interaction between different stages in circuitry and with the other channel.

The more powerful models are equipped with a heat-loop cooling system for the output stage transistors. This NASA invention enables the heat dissipated at high power levels to be rapidly removed so that a considerably improved power-to-size ratio is obtained.

If you see your hi-fi as an investment and, if you demand critical performance standards as well as the best value for money, listen to the future.

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SIGHT & SOUND news

Shopping for speakers?

Your 'one-stop speaker shop' is Electronic Agencies, according to proprietor Bill Edge, because you can choose from a wide variety of drivers from the Coral, Philips, Motorola and Foster ranges.

Apart from the renowned Philips' drivers used in the ETI Series 4000 range of quality build-it-yourself loudspeakers, Bill keeps a good selection of popular drivers from the well-known Coral range.

The Coral 8F-60 is a 200 mm diameter driver featuring a 1.23 kg, 160 mm diameter magnet, an extended frequency range and a die-cast frame. Voice coil impedance is given as six ohms minimum, the lowest resonant frequency as 35 Hz, sensitivity as 93 dB and the programme input as 40 watts. It may be used in a three-way system with Coral's HD-60 hard-dome tweeter or H-60 horn.

The 10F-60 is a 250 mm diameter driver featuring a 180 mm diameter, 1.88 kg magnet. It will handle 60 watts and the sensitivity is quoted as 94 dB. Voice coil impedance is also six ohms and the fundamental resonance is quoted as being 30 Hz. Again, you can team it with the HD-60 tweeters.

The 10L-60 is a 250 mm driver with a long-throw voice coil, rated at 60 watts, having a 160 mm diameter magnet and a 28 Hz fundamental resonance. Although generally similar otherwise to the 10F-60, it is recommended for use as a bass driver in either a sealed box or bass reflex enclosure.

Big daddy in the Coral range stocked by Electronic Agencies is the 12L-60, a 300 mm driver featuring an Alnico cast magnet and a power rating of 80 watts. The lowest resonant frequency is quoted as 27 Hz and output spl as 95 dB/W-m. Voice coil impedance is a nominal eight ohms and the unit is recommended for use in two-way and three-way systems.

The Coral speakers each come with specifications and application notes on enclosures and systems in which drivers may be used.

For those into the disco and sound reinforcement scene, the range of Foster drivers and Motorola piezo tweeters will be of interest.

To help with selecting speakers, Bill Edge has built up a 'selecta-speaker' system, with which you can select and compare a whole host of drivers by actually listening to programme material and switching through them.

You'll find Electronic Agencies at 115 Parramatta Road, Concord NSW 2137, or on the end of a 600 ohm line at (02)745-3077.

Concord cartridges available

Phodis recently announced the availability in Australia of Concord's range of low-mass, high performance moving coil and induced magnet cartridges.

There are six cartridges in the range. Two are induced magnet models, which means that they share the fixed coils of moving magnet type cartridges, but the magnetic field presented by fixed magnets is varied by a small moving armature attached to the cantilever.

The other four models are moving coil devices, the CMC-40 being a 'low output' device, the other three being 'high output'. High output cartridges can be interfaced directly with standard phono preamps without the need for transformers or pre-preamps; low output cartridges require a matching device.

Phodis claim that the positive response and sonic qualities, coupled with competitive pricing, make Concord cartridges an attractive investment, and give new, high-class technology to hi-fi enthusiasts previously unable to afford it.

For further information contact Phodis Pty Ltd, Phodis House, 5 Campbell St, Artarmon NSW 2064. (02)439-8900.

Are you into organs?

If you appreciate the sound of modern organs and organ music then you'd undoubtedly appreciate getting right into your instruments. It's easy with a kit, say Cleftronics, who market the Wersi range.

Wersi organs are renowned world-wide and there's a big range from which to choose. You can start at the 'beginners' end with the Entertainer model. This has a full 4-octave keyboard with polyphon voices like 16' horn, 8' tibia and 8' clarinet. Pitch vibrato can be added to these voices with adjustable speed and intensity. The Entertainer also features six automatic rhythms, ranging from march to swing, which can be used individually or in any combination. You can also add bass guitar, three percussion instruments and piano voice. The kit has a 10 W power amp and speaker and can be powered from ac mains or 12 Vdc. It's easy to build, according to Wersi, and makes an ideal practice keyboard.

For something more versatile — and portable to boot — see what the Combo model offers: two manual 4-octave keyboards; seven drawbars (16' to 1'); 15 fixed stops — voices such as cello, horn, trumpet, sax, violin, piccolo, etc; variety of attack/sustain functions; special effects such as solo/legato percussion, repeat, contracussion, tremolo, hand wah-wah, variety of autowahs, etc; six piano voices; range of vibratos, reverb; rhythm selection; string orchestra ... and on, and on! The attractive and functional case has steel pedals and base, and covers are vinyl clad, bench is adjustable. The lids close up the organ top and the integral base and leg structure turns into carrying handles (requires two roadies, estimated!).

Right at the 'top end' is the Concerto model, W3A. This unit has such an incredible array of features and functions we just haven't enough room to fit it in!

We suggest you contact Cleftronics for a detailed catalogue — which lists a host of other goodies, such as Wersi electronic pianos, rhythm units, auto accompaniment units and even synthesisers! Cleftronics are located at 9 Florence St, Burwood Vic 3125. (03) 288-7899. Demonstrations arranged.

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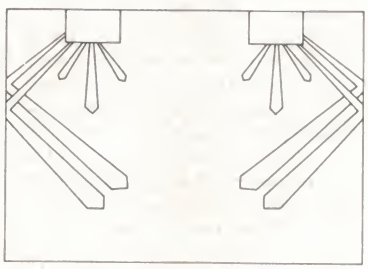
The new Bose Model 301 incorporates a number of exclusive features which put its level of performance way above any bookshelf speaker made. Exclusive Direct/Reflecting® speaker design utilizes a proper balance of reflected and direct sound to give you the spatial realism of a live performance. Exclusive Direct Energy Control lets you shape the sound to fit the acoustics of your listening room. Exclusive tweeter-protection circuit lets you drive the Model 301 really hard. Compare features. Compare performance. Then compare price. You won't find the open, spacious sound of the Model 301 in any other bookshelf speaker. Come in today for your demonstration.



Balance of reflected and direct sound gives the Model 301 the spatial realism of live performance music.

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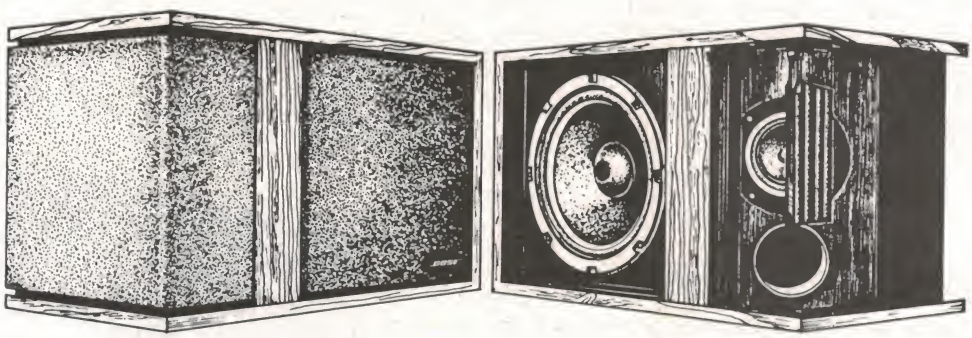

Patents issued and pending.

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THD analyser for audio circuits

This article describes a spot frequency audio distortion analyser, designed and built by a reader, Laurie Tunnicliffe of Mulgrave, Victoria. Measurements can be made at 100 Hz, 1 kHz and 10 kHz, and the final resolution of the instrument is 0.01%.

IN RECENT YEARS there has been a trend towards considering the transient behaviour of audio circuits rather than their steady-state behaviour. Although the attention given to this side of circuit design is not unwelcome, total harmonic distortion (THD) analysis is far from redundant.

While the transient behaviour is a go/no go situation, the THD behaviour is a measure of how well a circuit will perform. For instance, it is not a question of to what degree an amplifier will slew limit, or to what extent the internal loop will overload; these transient characteristics are barriers, and until reached will have no effect on the amplifier's performance.

THD measurements are therefore still a valuable analytical tool when developing new circuits or measuring and giving figures of merit to existing circuits.

When a single frequency is passed through an amplifier with a non-linear transfer curve, other frequencies are produced. These other frequencies are integer multiples of the test signal and sum of these is the THD.

There are a number of ways of measuring the harmonic distortion of an amplifier. The most recent is the 'Fourier Analyser', which is a computer-based instrument that samples the output waveform and performs the necessary mathematics (Fourier transform) to break down the waveform into its component parts. These instruments however cost tens of thousands of dollars. A technique becoming popular is the use of a spectrum analyser, which is a swept bandpass filter. The results are displayed on a CRO. THD is then calculated from

$$\text{THD} = \sqrt{\left(\frac{F1}{F}\right)^2 + \left(\frac{F2}{F}\right)^2 + \left(\frac{F3}{F}\right)^2 \cdots}$$

N.B. Square root sign in formula applies to sum of all terms.

Another technique used by Quad and described elsewhere[1], compares the input and output of an amplifier (using a differential amp), the difference being distortion. In Quad's experiment, music is used as the source and a monitor amp/speakers are used to listen to the distortion played by itself. This then becomes a 'real-time' distortion analyser, and any non-linearities, whether transient or steady state, are revealed.

The last and most commonly used method is to eliminate the fundamental signal and read the resultant harmonics on a moving coil meter. This is sometimes called 'Noise and THD' measurement, as hum and 'electronic noise' are lumped together with the harmonies. This is the technique used for the instrument presented here.

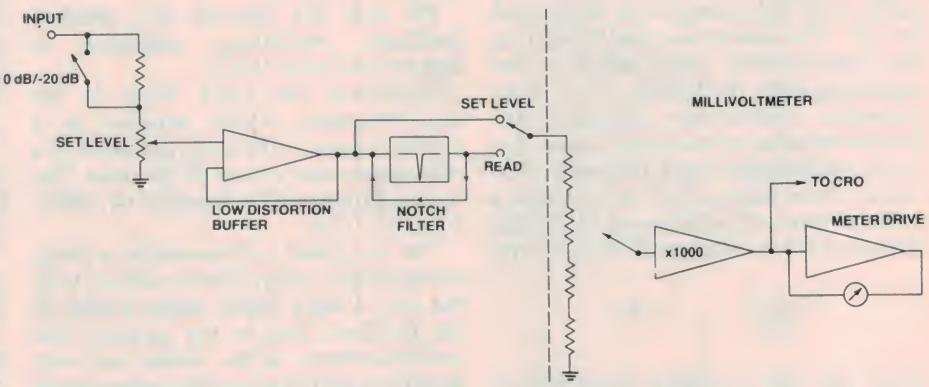


Figure 1. **Block diagram of the THD analyser described in this article.**

Block diagram

Refer to Figure 1 for the instrument's block diagram.

The input is applied to a buffer stage via a 0 dB/−20 dB attenuator. This allows easier control of the 'set level pot' when large signal levels are being measured. The buffer stage provides a low impedance source to drive the notch filter. The design of the buffer is of major consideration, as any non-linearities it contributes will be indistinguishable from the signal being tested.

There are a number of options available when designing a notch filter. A derivative of the Wien bridge was chosen due to its simplicity and the fact that it only requires two variable reactances to balance.

Bootstrapping around the filter is necessary to tighten up the notch width. Without this, the attenuation of the second harmonic would be excessive. With the amount of bootstrapping used the second harmonic is attenuated by less than 1 dB.

The notch filter is followed by a millivoltmeter and reads the average value of the harmonics relative to the fundamental. The meter is calibrated to read full scale for 0.775 V RMS input, and therefore the meter can be used separately to measure dBs into a 600 ohm load, relative dB (dBV) or millivolts, giving the instrument a dual function.

A CRO output is taken after the x1000 amplifier, so that the residual harmonics can be investigated. This will often give considerable insight into the cause of the distortion. ▶

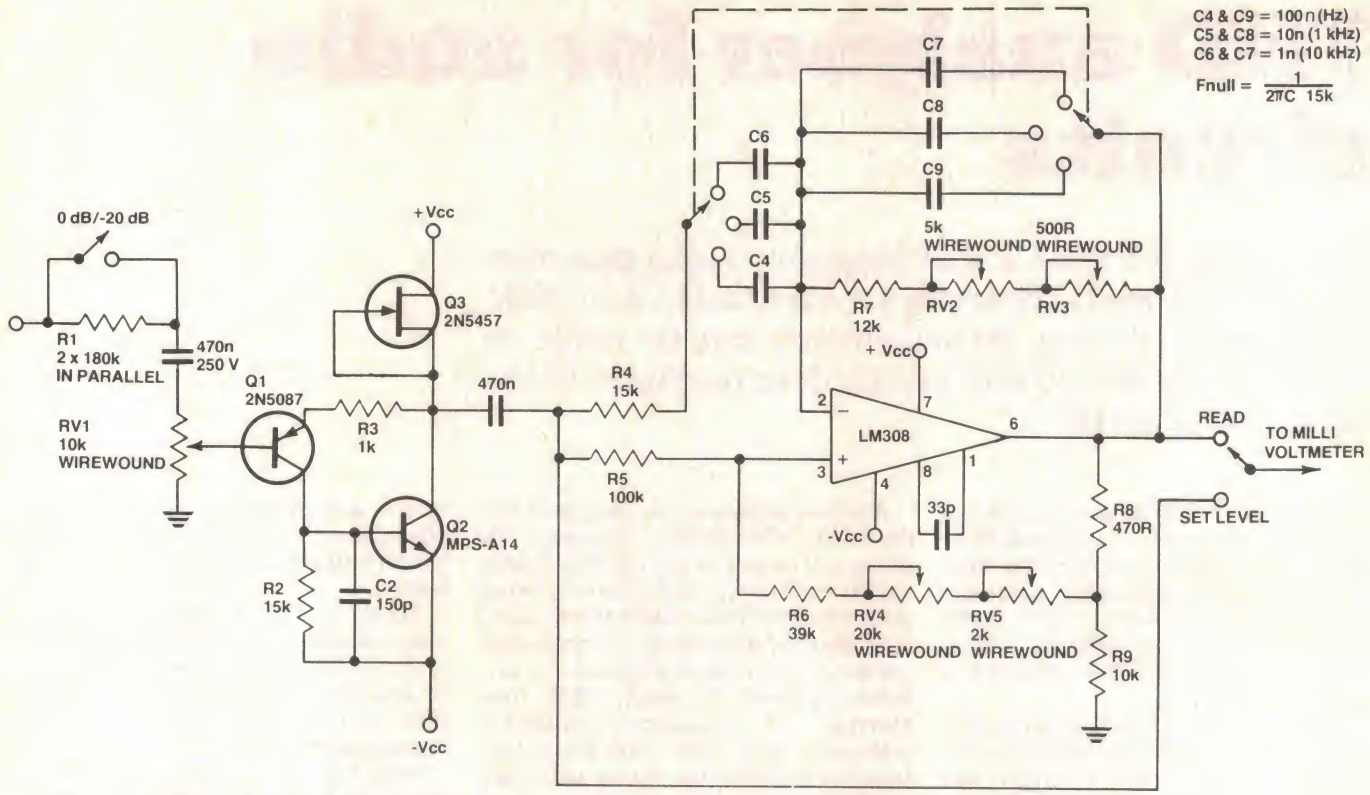


Figure 2. **Circuit diagram of the THD analyser (above and opposite).**

Circuit description

By examining Figure 2 the complete circuit diagram can be understood.

Q1 and Q2 form the non-inverting buffer with Q3 acting as an active load for Q2. The distortion contributed by this stage can be calculated to a first approximation as follows. The input transistor contributes negligible distortion relative to the second stage, due to the small signal levels it handles. The second stage is the prime mover, with a voltage gain of approximately 60 dB. The base drive voltage will therefore be

$$\frac{.775 \times \sqrt{2}}{1000} = 1.1\,\text{mV}$$

peak and the distortion generated is 1.1% second harmonic[2]. Since the buffer stage has 100% feedback (unity gain), the loop gain is also 60 dB and the distortion is reduced to

$$\text{loop gain} = \frac{1.1}{1000} = .0011\%$$

The buffer feeds the notch filter, which may be looked upon as a frequency dependent differential amp. At the notch frequency, the parallel arm and the series arm balance to give the same impedance ratio as the resistive arms. The input then appears as a common mode signal to a differential amp, and the output is zero. The common mode rejection ratio of the op-amp is of particular importance; however, most op-amps have a CMRR of at least 80 dB, which is sufficient to give a 0.01% resolution.

R8 and R9 provide the positive feedback (bootstrap) necessary to tighten the notch width.

Following the notch filter is the millivoltmeter, which consists of a constant gain, x1000 amp, preceded by a step attenuator giving 20 dB steps. The meter ranges will therefore be 100%, 10%, 1%, 0.1%.

The amplifier is followed by a fairly conventional meter-driven circuit, with the four bridge diodes being placed in the feedback loop of the op-amp. The non-linearities of the diodes are rendered insignificant and the meter reads accurately, even at the low end of the scale. Diodes 5 and 6 are used to protect the meter from an overload.

In order to achieve a wide enough bandwidth for the x1000 amp, an externally compensated op-amp was necessary. The op-amp used in the meter circuit is a dual low-noise device, and therefore helps to keep the instrument noise level low and reduces parts count.

C12 rolls off the frequency response above 70 kHz. This helps improve the square wave response by reducing any ringing, and also reduces high frequency noise. This will allow measurement up to the seventh harmonic of 10 kHz, and should prove adequate.

Construction

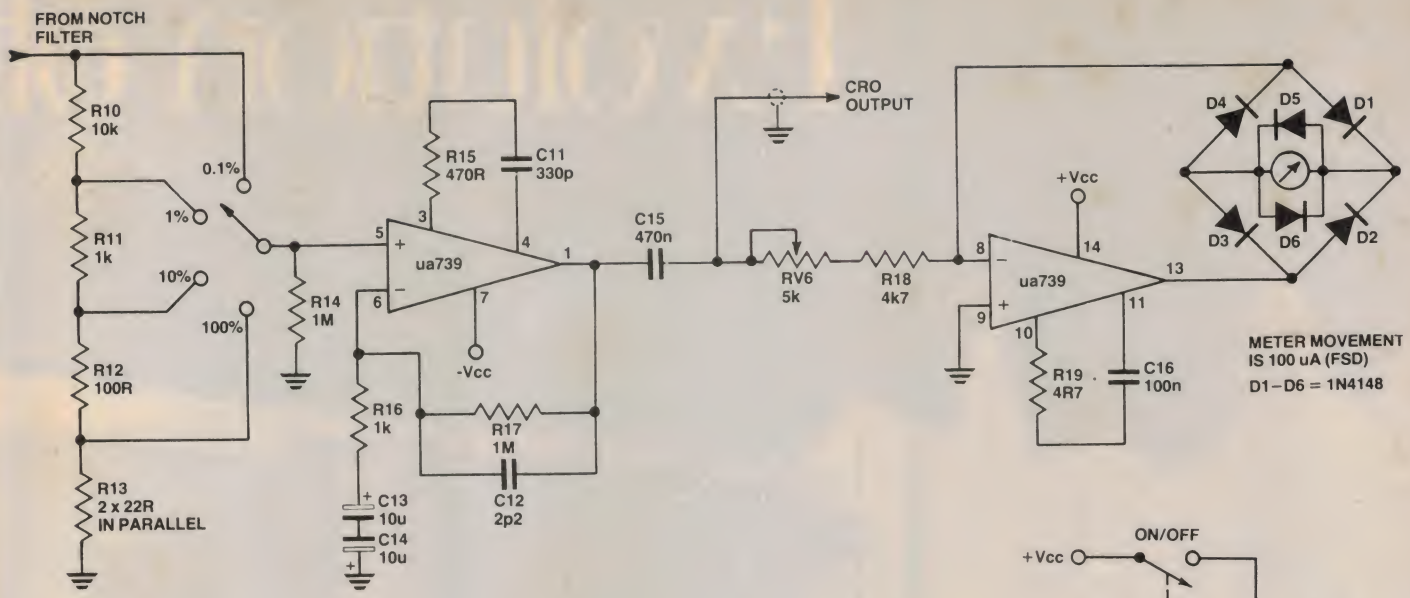
If accuracy and stability are to be reproduced, all components must be close tolerance, high stability. I used ¼-watt metal film resistors, which are available from Dick Smith. The filter capacitors are either styroseal or green caps; ceramic capacitors should be avoided as they are voltage dependent.

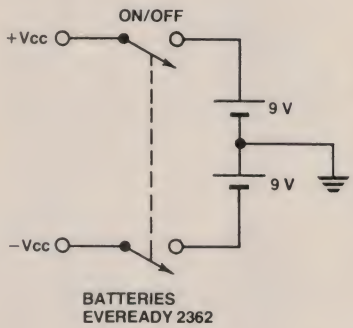
Veroboard should also be avoided, as stray capacitance across the strips causes problems when you are looking for one part in 10 000.

I used tagstrip and wire-wrap sockets for the ICs and found this easy to work with, giving satisfactory results.

My prototype was built in a diecast box; however, I had to rewire it three times, using shielded cable for every connecting wire, before a stable layout was found. For this reason I strongly suggest building the instrument as two separate units – a notch filter and a millivoltmeter. This will also give the versatility of being able to use one or the other independently.

The nulling pots are wirewound, having the advantage of a continuous track. The continuity of a wirewound pot is limited by the fact that a step in resistance equivalent to one wire winding is the smallest change possible. Carbon pots are certainly worse, as they sometimes jump resistance value mid-track. The fine control pots are single turn and provide reasonable ease of nulling at low levels. However, if you





feel it is worth the extra cost, ten-turn (spiral wound) pots will alleviate having to be careful when adjusting the controls.

The only adjustment to be done is the calibration of the meter. This is accomplished by applying a 0.775 V RMS, 1 kHz signal to the input with the unit switched to 'set level', and adjusting RV6 for full-scale deflection of the meter. Alternatively RV6 and R18 can be changed to 1k and 6k8 (fixed values) with less than 1% error in meter reading.

Operation

The instrument is operated as follows:

- Set Level/Read switch to Set Level
- Range switch to 100%
- Adjust Set Level pot for FSD of meter
- Set Level/Read switch to Read
- Adjust the nulling pots for minimum meter reading
- THD is now read from the meter and range switch.

The nulling procedure is accomplished by starting with the coarse pots, and alternately adjusting them for minimum meter deflection until it becomes difficult to proceed. The process is then repeated with the fine pots. If the user has a CRO available, this will assist the nulling procedure.

Figures 3, 4 and 5 show some oscilloscope photographs of the input and output of the meter. Figure 3 is an under-biased class B amplifier and shows spikes in the residual. This is a common waveform from class B amplifiers and the meter can be used to set the bias level for optimum.

Figure 4 shows second harmonic distortion from a voltage-driven common emitter amplifier. The input signal was 1.1 mV peak and the meter reading was 1.1%. This confirms the analysis used for the buffer stage.

Figure 5 is third harmonic caused by a thermistor-stabilised Wien bridge oscillator. THD was 0.02% at 100 Hz. (This is one of the problems encountered when using a thermistor at low oscillator frequencies.)

It should be noted that a low distortion oscillator will need to be used when making measurements. The residual distortion of the oscillator may set the lower limit to the measurements.

Some performance measurements

Final resolution of the meter was 0.005% at 100 Hz and 1 kHz and 0.01% at 10 kHz. Below this, drift in components' values with temperature, circuit noise, distortion introduced by the buffer and the filter stage and CMRR limitations of the filter all take their toll. However, distortion values of less that 0.01% are purely academic in my view, regardless of what hi-fi manufacturers' sales departments would have us believe.

References

1. P.J. Baxandall, Wireless World, November 1977, pp. 63-66.

2. E.F. Taylor, Wireless World, August 1977, pp. 28-32.

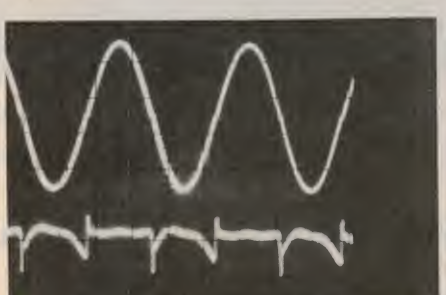


Figure 3. **Class B amp, meter reading 1.5%.**

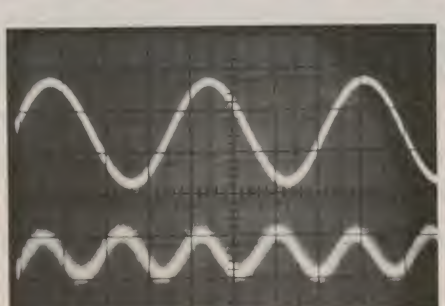


Figure 4. **Second harmonic distortion, meter reading 1.1%.**

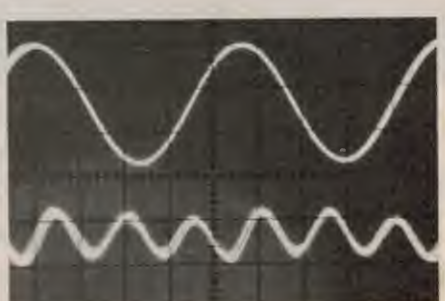
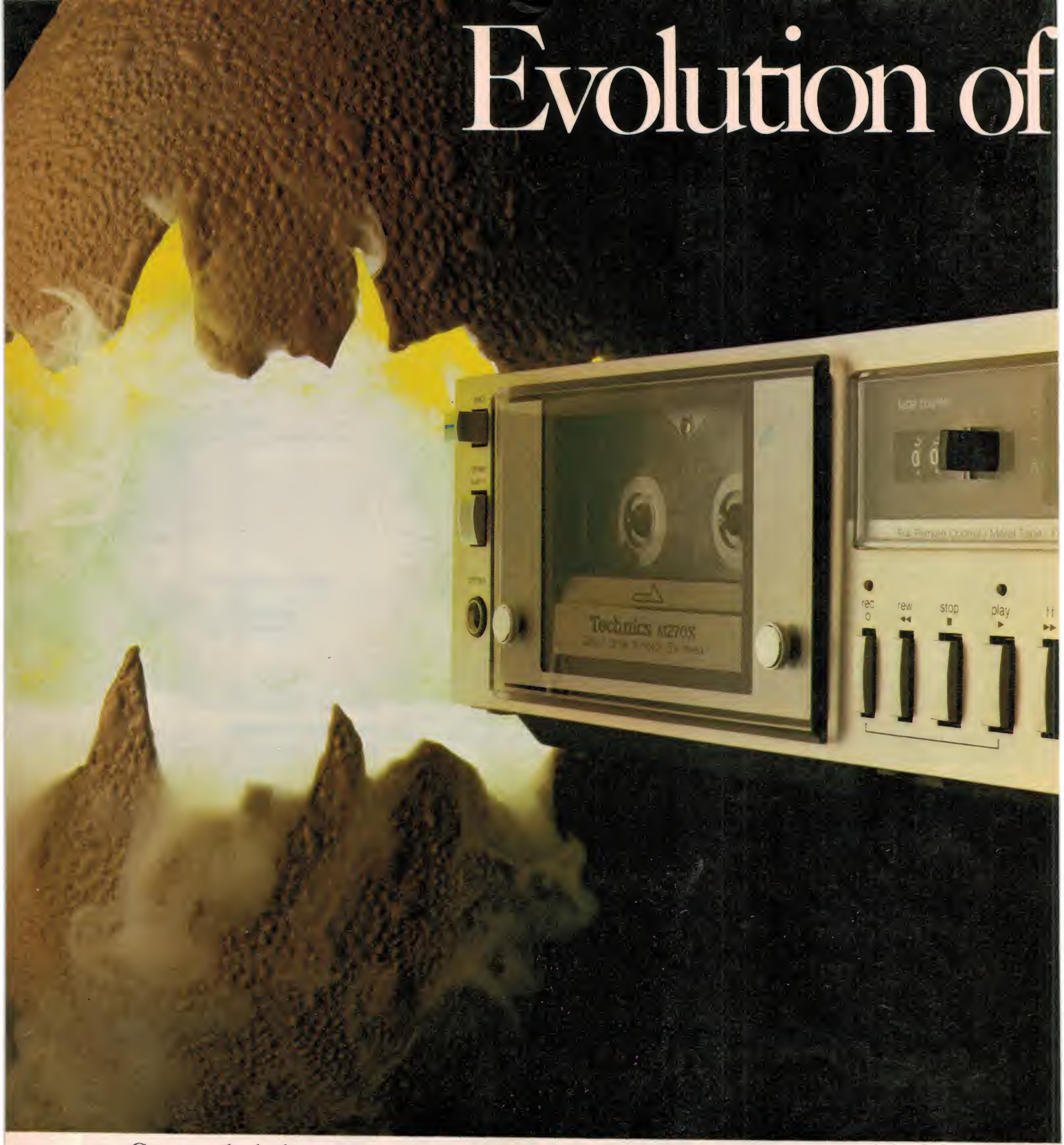


Figure 5. **Third harmonic distortion, THD 0.02%**

Evolution of



Cassette decks have come a long way to reach their current high standards of performance.

Now, Technics take them to an even more advanced stage of their evolution with a range of cassette decks featuring built-in 'dbx' dynamic range expansion.

At last you can enjoy cassette performance with a full dynamic musical range rivalling that of most reel-to-reel machines.

The 'dbx' system also functions as a very effective noise reduction system that cuts tape hiss by as much as 30db. To your ears that means tape hiss is virtually eliminated.

the species.

The benefits are not limited to cassette tapes either.

With a 'dbx'-equipped cassette deck like the superb RS-M270X you can also use your present system to play 'dbx'-encoded records as well.

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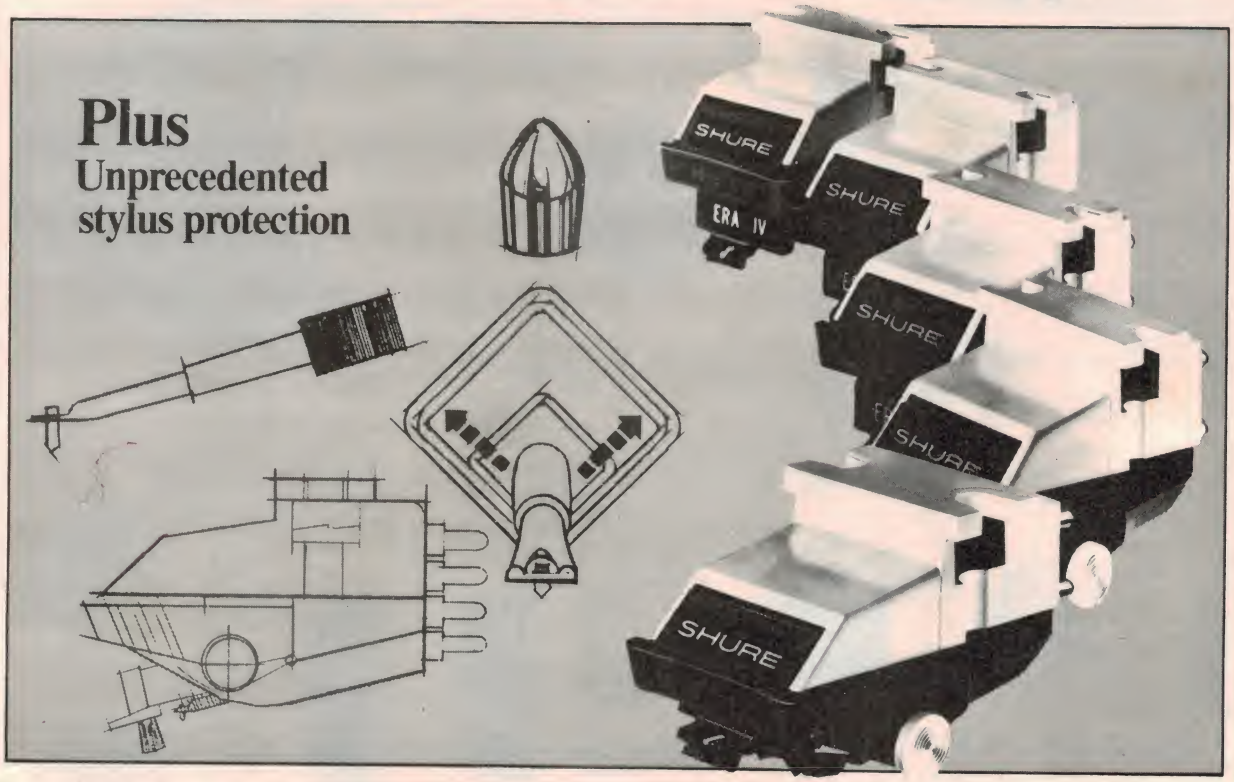

the M97 Era IV Series phono cartridges

Shure has written a new chapter in the history of affordable hi-fi by making the space-age technological breakthroughs of the incomparable V15 Type IV available in a complete line of high-performance, moderately-priced cartridges: the M97 Era IV Series Phono Cartridges, available with five different interchangeable stylus configurations to fit every system and every budget.

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AE 16I

Slide/tape synchroniser

WITH THE AID of a tape recorder and a slide tape synchroniser it is possible to obtain programmed slide changing with an automatic projector. By using a synchroniser and a stereo tape deck or recorder it is possible to have music and a commentary recorded on one channel and signals to give automatic slide changes at the appropriate points on the other channel.

A slide/tape synchroniser has two sections: a tone generator and an electronic switch. The tone generator is used to record short bursts of tone onto the tape at the points where slide changes are required. The electronic switch is fed with the tone burst output of the tape recorder and closes a pair of relay contacts for the duration of each burst. The relay contacts are used to control the automatic slide change mechanism of the projector. Usually the output of the tone generator is coupled to the input of the electronic switch, so that operating the tone generator causes the relay contacts to close. This is useful when recording a tape.

With the projector loaded with slides, the synchroniser connected to the projector, the output of the tone generator fed to one input of the recorder and the music/commentary signal ready to be fed to the other input, the tape is inserted. Then the music and commentary are recorded and the tone generator is operated at the appropriate times so that the slides are changed and the tone bursts are recorded onto the tape. If the tape is then rewound, the slide magazine brought back to its starting point and the tone burst output of the tape recorder fed to the input of the electronic switch, replaying the tape should give the slide show with accompanying soundtrack and automatic slide changing.

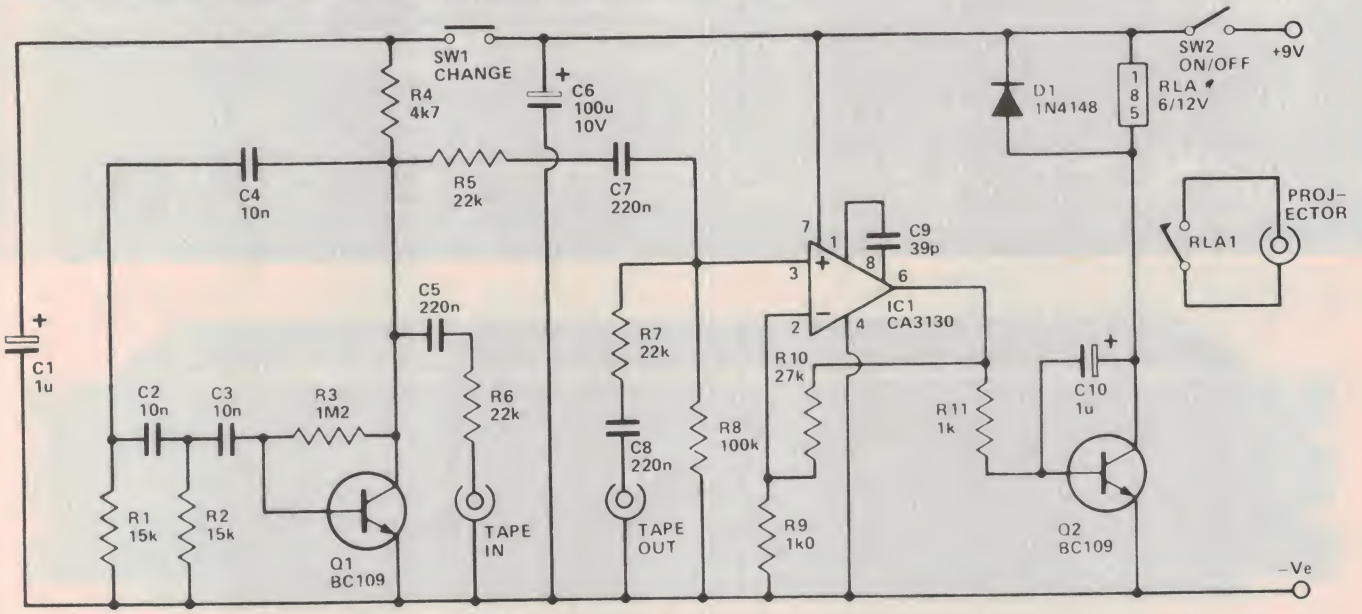
The operator only has to start the tape at the beginning of the show and stop it at the end.

A similar technique is used when using the unit as a programmed slide timer, the only difference being that there is no soundtrack to bother with.

The tone generator uses Q1 in a straightforward phase shift oscillator operating at about 500 Hz, although the exact operating frequency is not of great importance. It is merely necessary to use one at which the recorder is capable of operating reasonably well. The output from the collector of Q1 is coupled to the tape recorder by dc blocking capacitor C5 and resistor R6. The latter attenuates the output. R6 also ensures that the oscillator cannot be so heavily loaded that it ceases functioning. SW1 is a non-locking, push-to-make switch. It is briefly pressed to connect the supply to the tone generator and produce the tone bursts.

The tone generator is based on operational amplifier IC1, which is used in the non-inverting mode. Its voltage gain is set at about 28 by R9, R10, and R8 biases the non-inverting input to the negative supply rail. R5, R7 form a simple passive mixer at the input of IC1, so that it can be fed from either the tone generator or from the output of the tape recorder without the need for any changeover switching. The output of IC1 is used to drive common emitter amplifier Q2, which has the relay coil and protective diode D1 as its collector load. Normally IC1's output is low and Q2 is cut off, but in the presence of an input tone the output of IC1 goes strongly positive on positive-going half cycles. C10 integrates these pulses so that Q2 is continuously switched on in the presence of an input tone and the relay is energised. The relay contacts then close and operate the slide change mechanism of the projector.

The current consumption of the unit is only about 500 μA, but rises to around 40 mA during the brief periods when the relay is activated. The relay can be any type having a 6/12 V coil with a resistance of about 185 ohms or more, provided it has at least one set of normally open contacts of adequate rating



High-Com II

NOISE REDUCTION SYSTEM

Nakamichi

Obviously a noise reduction system that carries the Nakamichi logo has to offer some *real* benefits over existing systems.

Features like:—

- Professional two-band design affords 20 dB noise reduction throughout the *entire* audio band — necessary if side effects such as breathing, pumping and sonic coloration are to be eliminated.
- Ultra-fast attack and release times in each band assures accurate transient reproduction and minimal distortion — necessary for *faithful* reproduction of music.
- Optimum compander ratio for each band provides an additional 5 dB headroom affording a dynamic range improvement of 25 dB!
- 50 dB range peak responding meters assure correct record level monitoring.
- Subsonic and MPX filters eliminate externally induced errors.
- Suitable for any cassette or reel-to-reel recorder.

High-Com II follows Nakamichi's commitment to excellence in the fine art of recording.

SPECIFICATIONS:

Noise reduction system	2 bands, level encoding and decoding
Compression ratio	Encoding 1:2, Decoding 2:1
Noise reduction	20 to 25 dB
Frequency response	20 to 20 kHz ± 1 dB
Distortion	less than 0.1%
Dimensions	482(w) x 82(h) x 270(d)mm (fitted for 19'' rack mount)

High-Com is the trademark of AEG-TELEFUNKEN

For complete information on Nakamichi's High-Com II, see your nearest dealer or write to Convoy International Pty Ltd, 4 Dowling Street, Woolloomooloo 2011.

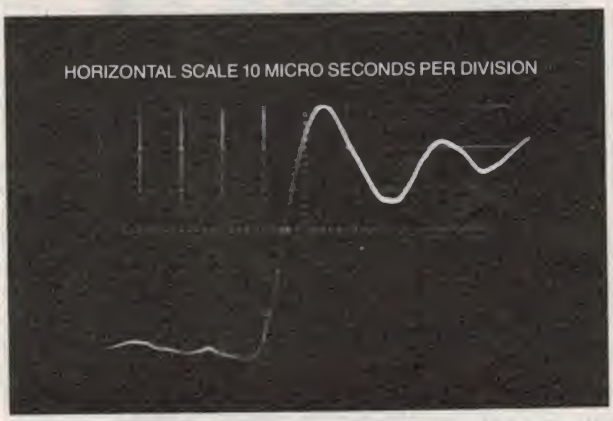
The moving coil replacement from Stanton Magnetics... the revolutionary 980LZS!

Now from the company to whom the professionals look for setting standards in audio equipment comes a spectacular new cartridge concept. A low impedance pickup that offers all the advantages of a moving magnet cartridge without the disadvantages of the moving coil pickup. At the same time it offers exceedingly fast rise time—less than 10 micro seconds—resulting in dramatic new crispness in sound reproduction—a new "openness" surpassing that of even the best of moving coil designs. The 980LZS incorporates very low dynamic tip mass (0.2 mg.) with extremely high compliance for superb tracking. It tracks the most demanding of the new so called "test" digitally mastered and direct cut recordings with ease and smoothness at 1 gram $^{+\frac{1}{2}}_{-\frac{1}{4}}$

The 980LZS features the famous Stereohedron™ stylus and a lightweight samarium cobalt super magnet. The output can be connected either into the moving coil input of a modern receiver's preamps or can be used with a prepreamp, whose output is fed into the conventional phono input.

For "moving coil" audiophiles the 980LZS offers a *new standard* of consistency and reliability while maintaining all the sound characteristics even the most critical moving coil advocates demand. For moving magnet advocates the 980LZS provides one more level of sound experience while maintaining all the great sound characteristics of cleanliness and frequency response long associated with fine moving magnet assemblies.

From Stanton...The Choice of The Professionals.



Actual unretouched oscilloscope photograph showing rise time of 980LZS using CBS STR112 record.

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Nakamichi 480Z cassette deck

Containing the new Dolby C noise reduction system, the Nakamichi 480Z cassette deck provides good results on both pre-recorded and home-recorded tapes.

Louis Challis

WHILST TAPE recorders have proved to be one of the most efficient means of recording music and other forms of programme content, they have from the very outset exhibited a limitation which disturbs the purist. That limitation is associated with the internal noise figure or lowest level of hiss that is capable of being achieved. Many solutions have been offered to this problem, the most recent of which has been the introduction of digital tape recorders whose dynamic ranges may be as great as 100 decibels or more. Not everybody however wants a digital cassette recorder, and particularly not at the current market price.

The average purist or amateur is seeking a reel-to-reel or cassette recorder which is capable of providing a dynamic range somewhere in the range 60-70 dB(A) on recording and with the compatibility to cope with any pre-recorded cassettes purchased.

Noise reduction

In ETI Feb. '72 we examined the performance of the Dolby B Noise Reduction System, which has become the most common system used on cassette recorders and quite a few reel-to-reel recorders as well. Ray Dolby, in developing that system, certainly produced a financial winner, and the licensing agreements and associated fees which have accrued over the period of the last ten years have been a godsend, not only for Dolby, but equally for the various tape recorder manufacturers who have achieved a degree of compatibility between their individual machines and pre-recorded cassettes which has accelerated the sales of these machines.

The trouble is that like any other encoding system, the Dolby B system has limitations, and this has been realised right from the very outset. The increases in distortion and the somewhat limited improvement in signal-to-noise ratio that the Dolby B system provides have worried Dolby Laboratories, who have spent a fortune in researching a new and improved system. At best this has been only 11 dB at the high frequency end of the spectrum and on some machines considerably less than this, i.e: 7-8 dB under adverse conditions.

More recently Dolby Laboratories have released an improved version of the Dolby Noise Reduction System, known as Dolby C, which is a two-stage encoding and two-stage decoding system that has, in theory, the capability of providing a significant improvement in terms of signal-to-noise ratio. The most important aspect, however, is its ability to provide effective noise reduction at frequencies as low as 150 Hz, whilst the Dolby B system does not become effective until frequencies of 500 Hz and above.

The goal for the new Dolby C system was not simply and arbitrarily 'more noise reduction'. A number of devices, such as dBX wide-band compandors, have long been available, and provide more noise reduction than Dolby B under some signal conditions, most notably in the absence of signals altogether. However, these devices also introduce such side effects as noise modulation and overshoot distortion under other signal conditions.

Thus an important objective for Dolby noise reduction was minimising the side effects, and there were a number of other related goals. The first of these was the quantity and quality of noise reduction. With a companding noise reduction system, the greater the noise reduction desired, the more the signal must be manipulated by the encode/decode process, and thus the more likely that side effects will be audible.

Dolby Laboratories decided that Dolby C would not trade more noise reduction for more audible side effects than had Dolby B. This decision was not only reflected in the design of the system, but also in the choice of the amount of noise reduction the new system provides. To minimise the signal processing required, it was necessary to establish the minimum amount of noise reduction required to meet the likely demands of the market. It was concluded that for cassette recording 20 dB of noise reduction would provide a noise level below that of any current or likely future program source, and would indeed result in tape noise below the ambient noise level of most home listening environments.

For a noise-reduction system to be practical, it must be reasonably tolerant of errors introduced by the recorder at both high and low frequencies between encoding and decoding. Dolby B-type

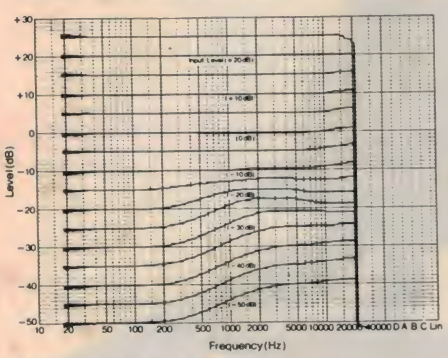
noise reduction has proved to be reasonably tolerant enough of such errors to be practical, so a similar tolerance was an objective for Dolby C.

The Dolby C system

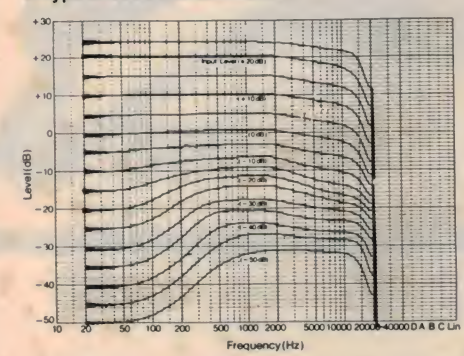
By using a two-stage encoding system, the overall improvement of the Dolby C System may be as high as 13 dB over the low frequency end of the spectrum and as much as 20 dB over the frequency region 500 Hz to 20 kHz. This is achieved by utilising two processing integrated circuit stages in series, each supplying approximately 10 dB of compression during the recording and 10 dB of expansion during playback.

The two circuits operate at independent levels. One is nominated and specified as the high-level stage and is sensitive to signals at about the same levels as those in the Dolby B-type noise reducing circuit, whilst the other, the low-level stage, operates on signals at somewhat lower levels.

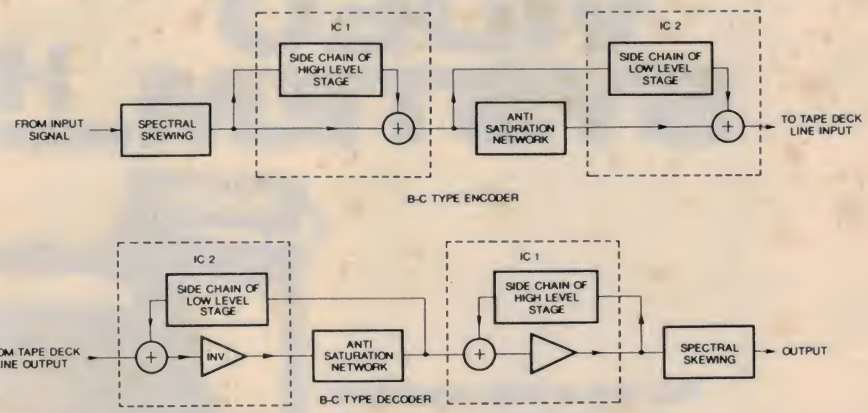
Not surprisingly, the two conventional Dolby IC chips are used in a modified manner to achieve the C-type noise reduction, and by this means it is possible to use one chip by itself as a Dolby type B encoder. The tape recorders incorporating the C-type noise reduction system are therefore capable of providing both a B-type characteristic and a C-type characteristic at will.



B-type encode characteristics



C-type encode characteristics



Block diagram of the Dolby B-C type noise reduction system.

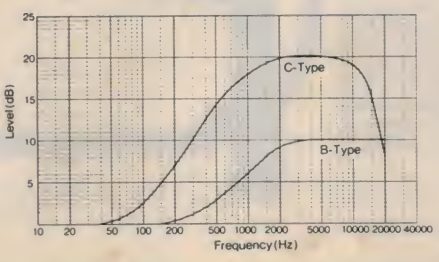
In the C-type mode two additional special circuits are incorporated to make the system function. The first is a *spectral skewing circuit*, known and designated schematically as the SN circuit, as well as an anti-saturation network (ASN), which adjusts the system response to avoid high frequency demodulation and thus effectively increase the headroom.

The spectral skewing circuit suppresses certain signal levels over 8 kHz during encoding or recording, and compensates this totally in decoding (during playback). Its purpose is twofold. Firstly, to prevent the deterioration of the tape's high frequency response as a result of the emphasis action, and secondly to prevent intermodulation of low frequency content caused by high frequency saturation during the emphasis phase of the action.

The anti-saturation network operates to raise the tape saturation level and thereby maintain the overall system alignment and performance.

The 480Z

The Nakamichi 480Z Cassette Recorder is the first machine that we have seen incorporating both Dolby B and Dolby C noise reducing systems. The 480Z is in fact the simplest and least expensive of the 480, 481, and 482Z Series Recorders just released by Nakamichi. The basic difference between the 480Z and the other two units is that it incorporates a two-head system whilst the others are three-head machines.



Low level Dolby encoding frequency response.

Whilst one would expect that the 480Z would suffer considerably in terms of performance as a result of this compromise combination of two heads versus the three-head system, nothing could be further from the truth. In fact, as our investigation showed, the performance of the 480Z is better than many other top-line three-head machines and quite a few of the earlier three-head machines produced by Nakamichi.

The appearance of the 480Z is not unlike the previous 480, 481 and 482 Series machines, which we have previously evaluated and reviewed in this magazine.

The front panel of the 480Z machine features, on the left hand side of the deck, a power switch at the top front and a bias control for fine tuning the bias current so that the characteristics of a particular brand of tape may be optimised over those automatically set by the selection of the type 1, 2 or 4 tapes. (EX, SX or ZX tapes).

Below the fine bias tuning is a headphone socket, which provides two fixed output levels for monitoring the headphones. To the right of these three controls is the cassette well, which is pneumatically controlled by an eject button located to its right. Whilst the system is described as the silent mechanism drive, the double capstan drive is not silent per se and is readily audible when one is close to the deck during playing. ▶

HITACHI VIDEO SYSTEM

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You buy a video system to put more fun in your life. To expand your viewing possibilities. To turn your TV into a multi-use entertainment center. For optimum enjoyment, you need two things: versatility and creativity. The Hitachi VT-7000 Portable Video System gives you an abundance of versatility. The creativity, you've already got.

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- Still picture & frame advance
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You'll be able to enjoy a wide variety of prerecorded tapes: old and new movies, cultural events, educational materials, and a fast growing list of rock concerts. The VT-7000 Recorder and A-V70 Adaptor are all you need for full playback convenience. And thanks to Hitachi's advanced technology, the picture (and sound!) quality are excellent.

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With the addition of the VT-TU70 Tuner/Timer, you're assured of never missing another must-see show. If an appointment or a trip takes you away from home, just set the VT-TU70 to record it, then watch it later at your leisure. You can preset to record a program up to 10 days ahead, or for daily repeat recording. In addition, you can tape one show while watching another.

The VT-7000 Portable Video System is a totally versatile, total enjoyment system. Not only are the units lightweight and compact for take-along convenience, but their elegant, matching design makes them look great in any home. And their performance and reliability are outstanding, thanks to Hitachi's world leading integrated technology. No matter what type of application appeals to you, you'll find that the VT-7000 System makes it easier and more enjoyable.

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The VT-7000 Portable Video System. Let your nearest Hitachi dealer show you the fun.

HITACHI

Across the top of the cassette escutcheon is an illuminated clear plastic bezel behind which is a three-digit tape counter, which is reset to zero by a button immediately below. To the right of this are peak-reading level meters covering the range −40 dB to +10 dB. This uses LEDs based on a 16-segment array, with 10 LEDs covering the range —40 VU to 0 VU and a further six covering the range +3 to +0 VU.

In a line below the LED display are two parallel slide attenuator controls whose functional usage I have previously criticised and must do so once again. These are not a good ergonomic design feature and really should be paralleled for easiest usage.

In the bottom centre of the front escutcheon are the six controls to record, rewind, stop, play, fast-forward and pause, which are electromechanical but function extremely well. The five other controls at the bottom right hand corner of the deck are the memory on/off switch, a Dolby C or Dolby B encoding control switch, a noise reduction on/off switch controlling the C and B functions, two tape buttons — one for SX and EX (namely gamma ferricoxide or chromium type derivative) tapes and the other for metal tapes.

The last control is the 70 microsecond/120 microsecond equalisation switch. On the rear of the deck are two switches for selecting Multiplex Filter on/off and high level/low level headphone outputs. A remote control socket for inserting the optional Nakamichi RM-100 Remote Control Unit is provided, whilst the voltage selector for 120/240 V had been disabled in the unit reviewed. Inputs and outputs are provided by two pairs of co-axial sockets for connecting the cassette deck to the associated amplifier.

The inside of the unit incorporates a large motherboard with the main control functions located on it, whilst a satellite board, providing the special functions of the new 480 class recorders, is located immediately above. The wiring harness, leading to the plug-in sockets and wire wrapped connections on this board, is not typical of Nakamichi neatness, and it is possible that these may be different in the production models that will follow. In particular the number of add-on components on the rear of the main printed circuit board are atypical of Nakamichi construction and must also be presumed to be a feature of this early production unit.

The designers have taken obvious pains to angle the position of the main supply transformer and to provide what appears to be a mu-metal screen to minimise stray hum field leakage. As we found in our subsequent objective testing, this has not provided a complete solution. The control board for the LED record level indicator is located behind the front panel and is apparently automatic in its functional control. This display is a positive plus for users when compared with the two VU meters that it replaces.

The tape drive is based on the well-proved diffused resonance drive system that we have previously reviewed and, if anything, appears to be even slightly better in this particular machine.

The main chassis, lid and cover for the unit are fabricated from galvanised steel, with the lid and back panel being painted black to match the satin anodised finish of the front panel.

On test

The objective testing of the unit provided some outstanding results.

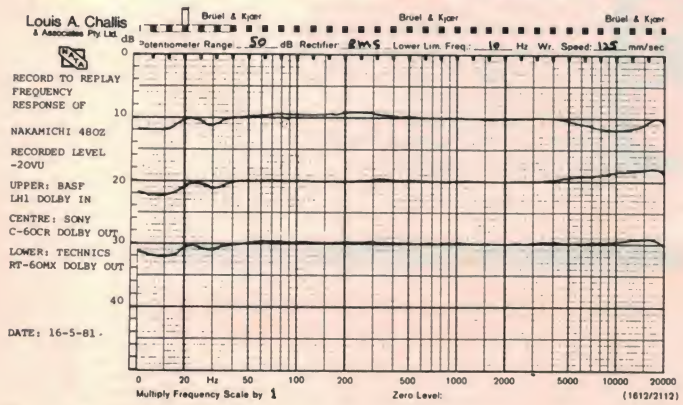
The first and foremost feature is that the replay frequency response of this machine is within ±2 dB from 10 Hz to 20 kHz with gamma ferricoxide tapes, within +1, −1.5 dB from 10 Hz to 20 kHz with chrome equivalent tape and within +0, −2 dB from 10 Hz to 18 kHz with metal tape. This is an *outstanding performance*, a credit to the manufacturer, and would be equalled with any pre-recorded tapes with correct azimuth alignment.

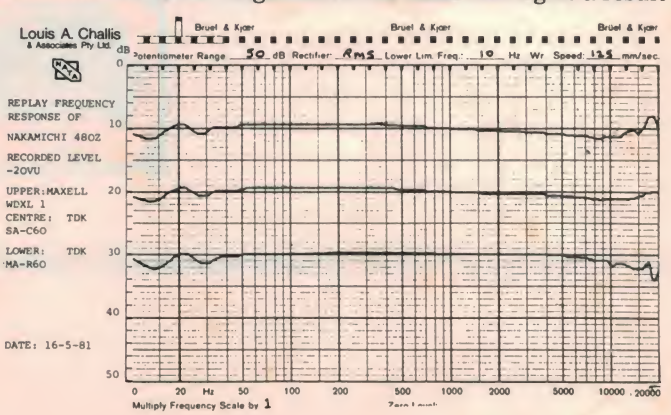
The record-to-replay frequency response is to all intents and purposes just as good, being +1, −2 dB from 10 Hz to 20 kHz with gamma ferricoxide tapes, −2 dB from 10 Hz to 20 kHz with chromium tape and +1, −2 dB with metal tape. With BASF LH1 tape used in the third series of evaluations the frequency response is better than most professional reel-to-reel recorders, being −20 dB within 0.5 dB from 35 Hz to 20 kHz and ±2 dB from 10 Hz to 40 Hz.

In evaluating the signal-to-noise performance of this machine one very quickly starts to appreciate the differences between straight recording, Dolby B encoding and Dolby C encoding. The improvements in signal-to-noise ratio in the critical 150 Hz to 1000 Hz region show up remarkably well in the level recordings which we produced, and with these you can readily see how this machine is able to achieve such high signal-to-noise ratios. Surprisingly, the overall A-weighted signal-to-noise improvement in the C mode is less than would be expected because of the extent to which hum at 50 Hz is able to pass through the encoding circuits.

Even allowing for this hum leakage, this machine still achieves a commendable 66.5 dB(A) signal-to-noise ratio in the Dolby C mode. If the hum level had been lower this noise figure would undoubtedly have exceeded 70 dB, and as such justifies the whole concept of the Dolby C encoding system.

The channel separation of this machine is remarkably good, the only significant intrusion coming as a result





MEASURED PERFORMANCE OF NAKAMICHI 480Z S.N. 1711

RECORD TO REPLAY FREQUENCY RESPONSE AT -20VU:

Tape	Dolby	Lower - 3dB Point	Max. Point and Frequency	Upper - 3dB Point
BASF LH1	in	10Hz	+1.0dB -25Hz	20kHz
BASF LH1	out	10Hz	-	20kHz
SONY C-60CR	out	10Hz	+2dB - 18kHz	20kHz
TECHNICS RT-60mx	out	10Hz	+1dB - 17kHz	20kHz

SPEED ACCURACY: -0.7%

MAXIMUM INPUT LEVEL:

(for 3% third harmonic distortion at 1kHz)

Tape: BASF LH1 +4.0VU

DYNAMIC RANGE:

Tape: BASF LH1

Dolby Out	-48.5dB(Lin)	-54.0dB(A)
Dolby "B" In	-50.5dB(Lin)	-63.0dB(A)
Dolby "C" In	-52.0dB(Lin)	-66.5dB(A)

SIGNAL TO NOISE RATIO: (Re OVU)

(Slightly degraded by residual hum in unit)

Dolby out	-50.0dB(A)
Dolby "B" in	-59.0dB(A)
Dolby "C" in	-62.5dB(A)

WOW AND FLUTTER:

WOW:	Average	0.2% P-P
FLUTTER:	Unweighted	0.1% RMS
	Weighted	0.05% RMS

ERASURE RATIO:

(for 1kHz signal recorded at OVU)

Tape:	BASF LH1	90dB
Tape:	TECHNICS RT-60MX	90dB

Date: 16.5.81

HARMONIC DISTORTION:

Tape: BASF LH1

		100Hz	1kHz	6.3kHz	
OVU:	2nd	-53.2	-56.8	-57.4	dB
	3rd	-37.1	-46.4	-41.0	dB
	4th	-59.5	-	-58.7	dB
	5th	-56.4	-67.9	-	dB
	T.H.D	1.44	0.5	0.91	dB
-6VU:	2nd	-54.7	-63.6	-56.0	dB
	3rd	-62.2	-61.8	-47.6	dB
	4th	-	-68.7	-60.1	dB
	5th	-62.0	-72.7	-	dB
	T.H.D	0.2	0.11	0.45	%

NAKAMICHI 480Z

Dimensions:	*450 mm wide, 135 mm high, 280 mm deep.*
Weight:	*6.4 kg*
Price:	*$599 rrp.*
Manufactured:	*In Tokyo by Nakamichi Corporation*
Distributed by:	*Convoy International, 4 Dowling St, Woolloomooloo, NSW.*

of the 150 Hz third harmonic of mains frequency. (This is not really a channel separation problem so much as a common component evident in both channels of the machine). The actual level of channel separation is better than 75 dB at 500 Hz and is still better than 45 dB at 20 kHz. These are good figures and indicate the extent to which better performance may well be achieved in the three-head versions of the same 480 class systems.

The distortion levels are also good. At 0 VU they are typically 1.5% at 100 Hz and less than 1% at the other frequencies. At −6 VU the distortion levels are particularly low, being less than 0.25% at 100 Hz and 1 kHz and still less than 0.5% at 6.3 kHz.

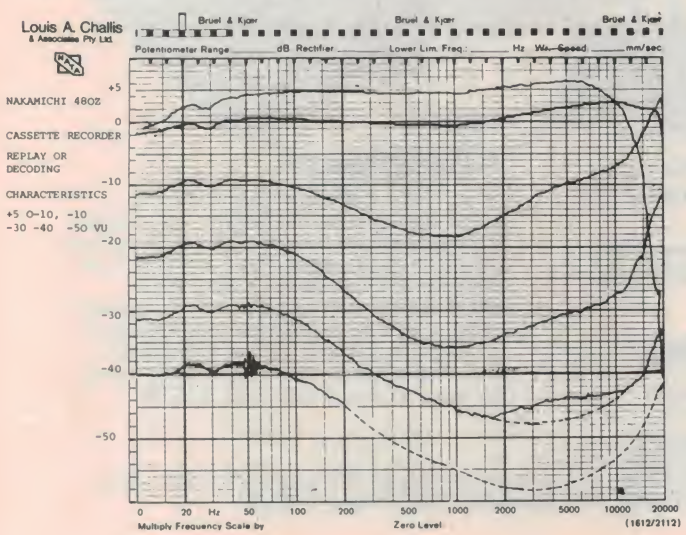
The erasure ratio is very good, being better than −90 dB on both standard gamma ferricoxide and metal tape.

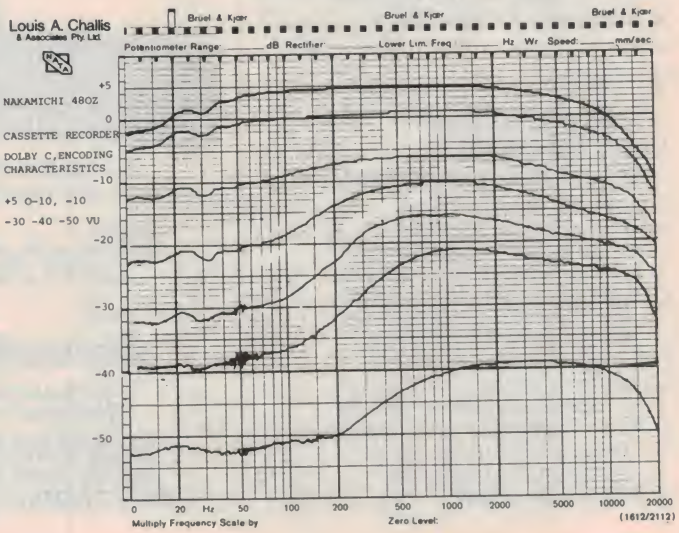
The wow and flutter figures are low at 0.2% wow peak-to-peak, whilst the weighted flutter is 0.05% RMS.

To the ear

The subjective evaluation of this machine was truly a delight in that the performance achieved on playback of pre-recorded tapes was outstanding. The performance achieved in recording material with Dolby C is also extremely good. The hum level is the only characteristic which is not typically Nakamichi. Without Dolby encoding this is −48 dB and as such was readily audible with my reference monitoring system. With Dolby C encoding this hum is −56 dB and is only just detectable.

The Nakamichi 480Z offers unusually good performance and facilities, especially with the new Dolby C noise reduction system, though one might well be tempted to pay the extra money for slightly better performance in one of the more advanced machines. At $599 recommended retail this is not a cheap recorder, but its attributes more than justify the price tag. ●





'The quality remains after the price is forgotten.'

Henry Royce, founder of Rolls-Royce, 1906.

ZEROSTAT
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The new red Zerostat Pistol is the latest version of a leader in it's field. The simplest way to remove static and it's associated symptons. Needs no refills, batteries or power supply and neutralises static charges in seconds. Lasts for at least 50,000 operations. **$24.95.**

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Sansui puts you in charge of your music.

Does listening to your stereo system make you feel like you're at a live performance? Of course it doesn't. And if you don't agree, either you've got a tin ear or you've never been to a live performance. The best a stereo system can hope for is to approach the rich dynamism of the real thing. And at Sansui, that's our goal.

One way we do this is to put you in charge of the way your system sounds. Nobody we know of has a listening room with the fine acoustics of a music hall. And none of the standard reproduction methods—discs, tapes, FM—can accommodate the full dynamic range of a symphony. That's why you need versatile take-charge stereo equipment like the SE-8, a full 10-band stereo graphic equalizer with a built-in real-time spectrum analyzer. In a nutshell, it lets you recreate an approximation of the original performance.

Even if you don't opt for the remarkable versatility of the SE-8, you get *four* tone controls—Super-bass, Bass, Presence and Treble—with the AU-D7 "Linear-A" DD/DC integrated amplifier. Plus, you get MC-cartridge capability and the pure-sounding Linear-A design that has eliminated switching and cross-over distortion completely.

And when you're ready for the vast treasure-trove of musical enjoyment available over the airwaves, we've got the matching TU-S7 Quartz Synthesizer Tuner. It offers 3 tuning modes including preset pushbutton tuning of 6 FM and 6 AM stations.

If you want your music to sound like a live performance, let Sansui put you in charge

AU-D7

TU-S7

(Also available in black finish.)

SE-8

Sansui

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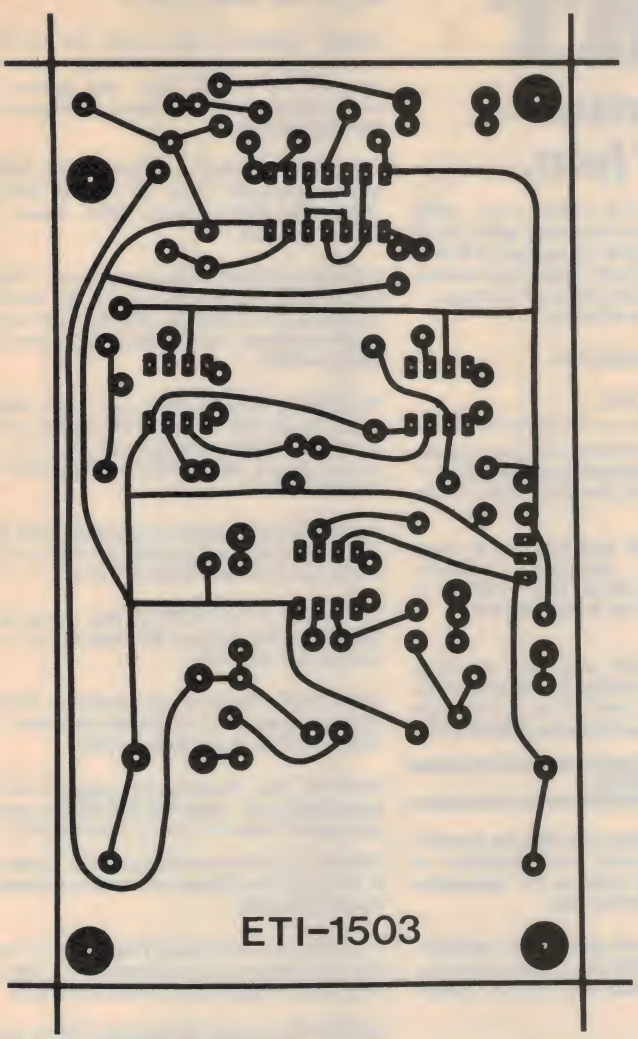
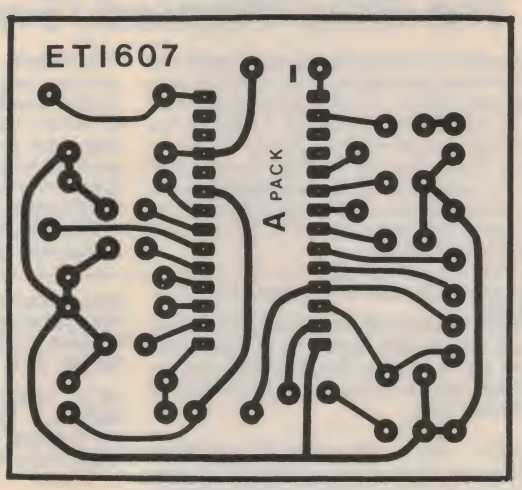
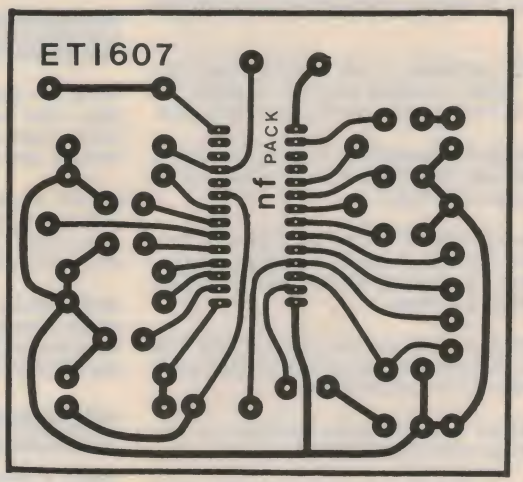
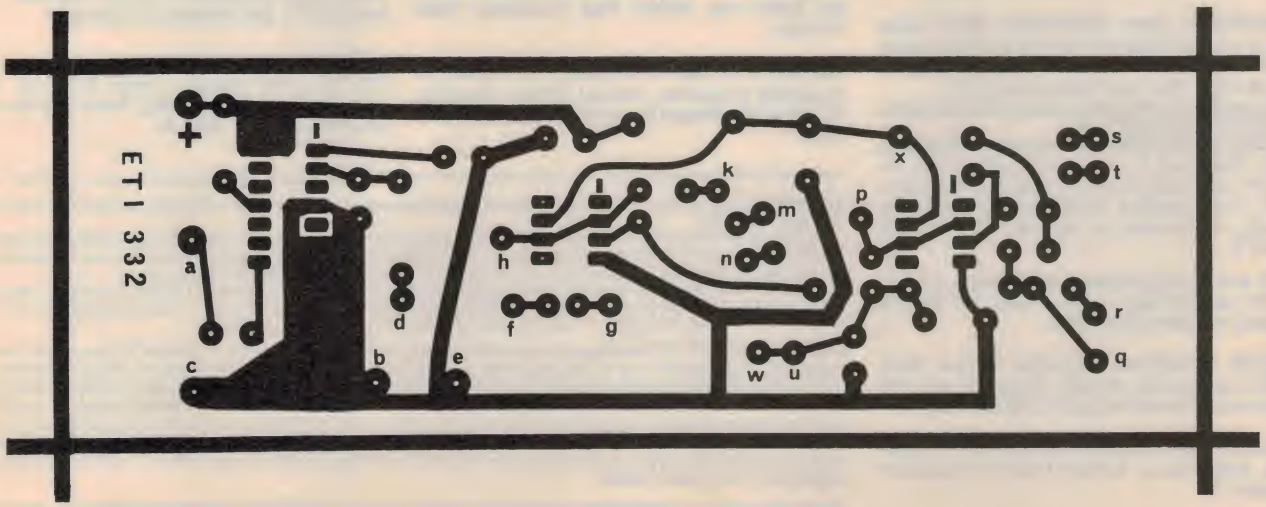






Instructions on how to make your own pc boards using the Scotchcal method and exposing through this page may be found on page 159 of the June '81 issue.



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SELL: 300+300 W RMS amplifier. Built and tested, including power meters. VI limiting and speaker protection built in. Dual power supplies, $650. Rod Smart (053)52-2487.

DAHLQUIST DQ10 Professionally modified mirror-imaged loudspeakers, $950. Quad 22/II valve system including tuners, $395. Quad AM3 tuner wanted. Brisbane (07)262-5168.

WANTED: Instruction manual and circuit diagram for Teac A-3300. Photostat copy acceptable. Will pay $10. R. Eldridge, 33 Rosella Crescent, Wulagi 5793.

WANTED: Goldring Lenco variable speed turntable. Details including price to D. Rintel, 133 North St, Toowoomba 4350. Phone (076) 32-4958.

TECHNICS SU-V6 amplifier, 70 watts per channel, 6 months old, $400. Write: Alan Ung, 40 Boronia St, Kensington NSW 2033.

FOR SALE: Thorens TD 166 turntable with TP 11 tonearm and ADC cartridge. Excellent condition, $180. Ian Cruickshank, 56 Forest Road, Launceston Tas. (003)31-4859.

FOR SALE: JVC add-on rear amp, 4 x 25 W RMS, inbuilt graphic equal. plus remote control. As new, $100. Phone Pat ah (02)759-5080.

FOR SALE: Kenwood audio de-noiser, as new, $40. Phone Pat ah (02)759-5080.

FOR SALE: Remote control for Teac RTR A4300, never used, $40. Phone Pat ah (02) 759-5080.

BOOMERANG TAPE RECORDING CLUB. Make friends all over Australia through tape recording. Lots of services offered. For information about the club, B.T.R.C., Box 155, Carlingford 2118.

MISCELLANEOUS

SELL: Resistors ¼, ½, 1, 5 & 10 W, approx. 100 000. Capacitors approx. 10 000, mixed values. 240 V 10 A, sockets, flush mount, 80¢ each. M. Sully, 61 Newman St, Niddrie Vic. 3042. (03) 379-2879.

RACK and card system/s (front panel ≈ 1 x 2m) wanted, second hand. John Jacobs, 959 Princes Highway, Engadine NSW 2233.

WANTED URGENTLY: Motorola diodes, thirty 1N4934 and twenty 1N4935. If anyone can help please phone Mark Buckley on (062)45-4283 b.h.

FOR SALE: Approximately 120 ETI and EA magazines, $20.00 o.n.o. Contact David Wilkinson on (03)469-3171.

SELL: Quantity of transformers, 120 Vac. Primary 24V 500 mA centre-tapped secondary 30¢ each. T. Pearson, 31 St. Pauls St, Randwick 2031. Phone (02)398-1861.

19"*8" RACK FRAMES, seconds, incl 8 cards holders, removable mounting brackets, 5¼"(3U),$25, Exorcisor/S100, $50, +PSTGE. J. Wicks, 1040 Heatherton Rd, Noble Park 3174.

LARGE STEEL CABINET with rack mounting suitable for modems, switchgear, small computer or test equipment. Size: 2 m x 0.7 m x 0.7 m. Front and rear doors. $200. Glen Waverley (03)560-6708.

COMMUNICATIONS

ICOM 551 Delta, 10 weeks old with log periodic yagi. Also digital readout communication receiver. Both as new, in cartons. HF transceiver wanted. Springwood (047)51-4050.

LUNAR Model HF3 solid state linear amplifier, 100 W, 3-30 MHz, SSB/CW/AM, 12 Vdc operation. New cond. Best reasonable offer. W.H.R. Treloar. Ph. (02)239-5267 b.h.

AUSTRALIAN RADIO DX CLUB: For shortwave, medium wave, utility and amateur listeners. Big monthly bulletin sent to all members. Details from: Box 227, Box Hill Vic 3128, for the cost of a stamp.

COMPUTERS

SELL: DG640 VDU, DG680 CPU, TCT 64K board with 16K, SECI, 6-slot motherboard, software (BASIC, Assembler, games). Cost $900 as kits, sell for $800 ono. Phone Paul Colquhoun (049) 77-1231.

FOR INFO ON TI-99/4 computer users group, or swapping programs, contact Shane Andersen, P.O. Box 101, Kings Cross 2011 or phone (02)358-6662.

SENSATIONAL ZX80 software. Send SSAE for list, $1.50 each or for 10+, $1.00 each. A.F.T. 15 Mitchell Ave, Tatura, Vic 3616.

SOUND EFFECTS and music for System 80 system tape with demonstration tunes, plus program to create your own effects, fully documented, $7.50. D. Johnson, 50 Bayswater Rd, Moonah Tas 7009.

FOR SALE: SOL-20 plus software, $900; 64K RAM, $550; Discus-2D plus 50 discs, $950; SM Electronics S100 chassis, $230. Phone: Mark (049)51-3880 a.h.

ZX80 new 8K ROM, instruction manual, "The ZX80 Companion", magazine copies of associated programs and materials, etc. Includes cassette player and leads. Value $350. Sell $300 ono. Phone (02)663-4830.

S100 CPU: Bought $330, sell $250, excellent condition. SD-SBC-100, 2.5 MHz, 2K Mon, 1K RAM, up to 8K PROM, parallel/series I/O, CTC, more! Andrew Heard, 18 Elsworth Dv, Banksia Pk 5091. (08)264-1055.

SYM-1 with 8K RAM/8K ROM BASIC, $200. KTM-2 (keyboard and video) in case with PSU, $250. Both $420. David Johnson (08)293-5605 a.h.

FOR SALE: 1 only SYM.1/KTM2 computer with BASIC and 16K memory, $400 ono. R. Hall, c/- P.O. Southbrook Qld. 4352.

SELL: Dream 6800 with 4K expansion board and power supply. Lots of software including dream invaders. $100. Phone (08)44-1765.

WANTED: Dec '80 and Jan '81 copies of 80-Microcomputing (U.S. mag). Will pay $5 per copy incl. postage. R. Rider, P.O. Box 26, Weston ACT. 2611.

STRINGY FLOPPY with 25 wafers for TRS80, $300. R. Worley, 9 Henderson Court, Glen Waverley Vic. Tel (03)233-1986.

AUSTRALIAN ZX80 Users Association is for you. For an introductory newsletter send a 30¢ stamp to: AZUA, 19 Godfrey St, Cambell ACT 2601.

ACTIVE filter design program for OSI C4, actually draws the circuit and calculated values on the VDU. $20 on 5" disk, $10 for listing only. P.O. Box 73, Lyneham ACT 2602.

CHIP8 — Programs and routines to share and swap. Offer of help to other beginners. Frank Rees, 27 King St, Boort Vic 3537.

HEATH H8 microcomputer, 16K RAM, serial I/O, BASIC, Assembler, Text Editor, $495. Heath H9 video display/keyboard, RS232 interface, $300. Mod 15 TTY, $50. VK3BSX (03)598-1034.

SELL: Watanabe X-Y/X-T recorder, full A3 size with roll chart adaptor, model WX-411R. Used once, $1800 ono. Phone Reg, Yowie Bay 524-5918 a.h., 525-2811, ext. 281 b.h.

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DREGS

LIFE WASN'T MEANT to be easy — a cliche variously attributed to M*lc*lm Fr*s*r, George Bernard Shaw and Pliny the Elder (* — fill in the spaces to suit yourself) — is readily recognised as a corollary of Murphy's law. Those of you who've been involved in computer programming could undoubtedly relate at least one memorable occasion when the adage applied. The learned gentlemen of the London Science Museum certainly could.

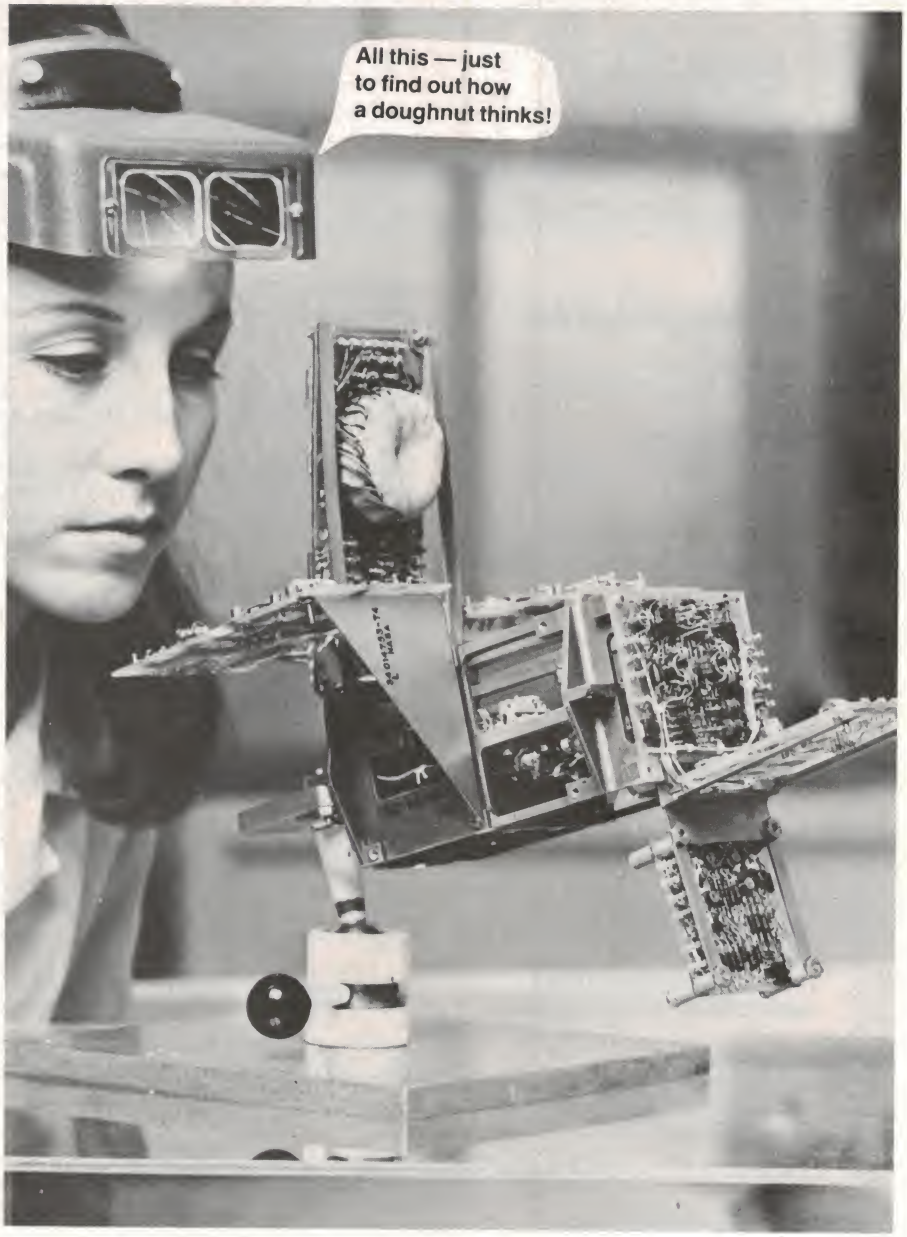
Back when 'personal' computers first began to trickle through to the public's imagination (1975-76), the London Science Museum set up a new gallery devoted to the history of computing science. Part of the display consisted of a computer terminal and video display for visitors to experiment with.

The Science Museum staff, realising that the odd visitor might fill the display with various graffiti, loaded the computer's memory with a vocabulary of unsuitable words and phrases.

If any such words were entered via the terminal the computer discreetly prevented them being displayed.

At least, that was the intention.

Apparently, the system worked quite well for a time until one day a teacher with a large class of genteel girls was faced with a display totally filled with obscenities — the computer had somehow contrived to display it's vocabulary of bad words!



King Kong meets Godzilla — in your lounge room?

A three-dimensional television set able to produce life-size images is to be jointly developed by two US companies, Design West Inc. and Biofuel Inc. If they get the product off the ground (pardon the pun) it will no doubt do wonders for the video recorder and software market. We have a few misgivings though; hence the heading. Imagine — King Kong in your lounge room, and life-size? We note that 'life-size' was not defined, however. That misgiving notwithstanding, just think what such a television would do for the 'skinflick' video companies!

Quotes comp.

You didn't **really** think we meant two years' sub. to E.A. (see last issue) was worth less than one?! This contest is more cunning than first glance reveals. To win second prize (twice the value of first prize) you have to have just sufficient incorrect answers to be one behind the person who happens to get one more right than yourself. If you're convinced you have all the correct answers, you have to deliberately put in some wrong ones. But how many? It's going to be interesting.

Incidentally, the contest closes with the last post of 30 September, 1981.

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The Biphonic System.

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If you'd like to know more about the many innovations JVC has brought to the stereo radio cassette recorder, write to us for a brochure, or call in to any JVC dealer.

Then you'll see why JVC equipment is recognised as The State of the Art.

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JVC0058/ETI/FMMH

JVC Advisory Service, Private Bag, Kingsgrove, N.S.W. 2208 or phone (02) 750 3777.

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